

INTERVIEW CLIFF LETT SPILLS THE BEANS!

Radio Control CAR ACTION

THE WORLD'S PREMIER CAR MAGAZINE

NOVEMBER 1991

FREE
RACERS' TRACKSIDE GUIDE
PULL-OUT

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**BATTERY
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Radio Control CAR ACTION

VOLUME 6, NUMBER 11

NOVEMBER 1991

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REFERENCE GUIDE
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without it!

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ON THE COVER: top right—Cliff Lett peers out of the pages of *Car Action*.
(Photo by Gene Husting.) Center—Project Lazer. (Photo by Steve Pond.)

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EDITORIAL

by STEVE POND



CAN'T SEE THE TREES; NEVER MIND THE FOREST!

ENJOYING and supporting the R/C hobby/sport is a double-edged sword. In R/C racing, to enjoy is to savor the spoils of victory. Sure, it's satisfying to get out to the track and engage in close competition—win or lose—but an occasional win helps to keep your interest and your spirits high.

Some racing categories, e.g., paved oval, are more "hardware-intensive" than others. This means that, to remain competitive, you have to surrender more of your hard-earned greenbacks. To keep the hobby and your bank account in balance, it's always best to seek the cheapest prices for your equipment. But this is where the sword's other edge becomes apparent: you can't buy your equipment at the best possible prices *and* support the hobby.

Many small manufacturers of R/C racing-related products (motors and batteries) sell directly to consumers by circumventing the proper distribution/hobby shop network. Some sell their wares at prices lower than those offered by hobby shops—claiming to be able to offer the same products for less by avoiding all the "middle men." In fact, the prices for the products offered by many of these "Robin Hood" manufacturers are only slightly lower. This means that the money you spend with them isn't supporting the hobby shop or the distributor; it's only thickening the linings of the Robin Hoods' pockets.

The bottom line is that hobby shops are the backbone of the R/C industry. The people there can supply you with all the products, support and information you need to enjoy the hobby. Manufacturers who dodge the hobby shop and the distributor that support them have only their own interests in mind, not yours! ■

LETTERS

WRITE TO US! We welcome your comments and suggestions. Letters should be addressed to "Letters," Radio Control Car Action, 251 Danbury Rd., Wilton, CT 06897. Letters may be edited for clarity and brevity, and each must include a full name and address or telephone number so that the identity of the sender can be verified. We regret that, owing to the tremendous numbers of letters we receive, we can't respond to every one.

FILM AT ELEVEN

I have an awesome idea; one that I think many readers would like! Why not videotape some of the major R/C events, i.e., the Nationals, the Worlds, etc.? I know a lot of people who'd be especially interested in the Off-Road World Champs. Now, I'm not talking about taping bits and pieces of races; I mean full race coverage like that given to the NASCAR races and the stadium-truck races. I don't mean to be

rude but, sometimes, reading about a race just isn't enough. Selling videotape coverage would make you money, and it would allow those of us who couldn't attend the races to see them.

Also, when are you going to interview Cliff Lett? Can you do a report on "Bad Brain" O'Brien's work area? It might be interesting (or scary) to some readers.

Frank Syse
RUSH CITY, MN

Frank, you've been beaten to the punch! A company is already working on a video of the 1/8-Scale Worlds that were held in Austin, TX. This company also plans to tape the Off-Road World Champs in Detroit. Covering all the heats and Mains

would require too much videotape (the off-road event lasts 10 days!), so probably only the highlights and the A-Main will be included. Even the Mickey Thompson Races are condensed and packaged to fit into one-hour episodes; the actual events often last for three hours or more! As for the Cliff Lett interview, check out this issue! A report on Bad Brain's work room is an interesting idea—hmmm.... —AS

JUST STARTING OUT

I'm a beginner in the R/C world, and I subscribe to your magazine. I have a few questions:

1. Is the Tamiya Manta Ray a good beginners' car?

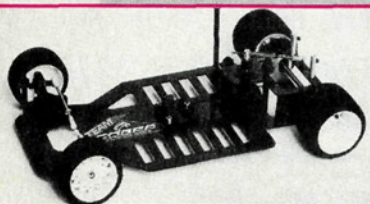
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John Broesler, TQ/Wins the A MAIN MODIFIED, wins the A MAIN STOCK!
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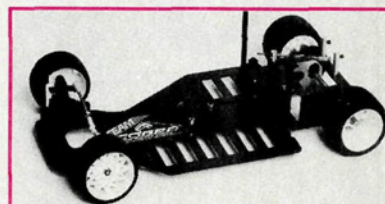
"After having owned and raced all other competitive 1/10th scale cars, I can say that nothing compares to a Cobra. It was so much smoother, faster, and easier to get dialed in, that I was immediately turning more laps than I had ever turned before."

John Broesler

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2. Will a Futaba 2PB Magnum Sport fit the Manta Ray?
 3. Can the Novak 410-M5 handle a hand-wound modified?
 4. Can the Manta Ray handle a modified?
- You guys have a great magazine!

Nick Parisi
MILWAUKEE, WI

Nick, you listed your questions in such an organized fashion, so I'll try to answer them in the same way. Here we go:

1. The Manta Ray is a good beginners' car: its great instruction manual all but builds the car for you! It's a good choice, but because it's a 4WD car, it requires a little more maintenance than a 2WD car.
2. The Futaba 2PB will fit most cars,

including the Manta Ray.

3. The 410-M5 can handle the power of a hand-wound modified motor, but use a motor with 16 turns or more. A motor with fewer turns might damage the controller.

4. The Manta Ray can handle stock motors and very mild modifieds in the 18- to 22-turn range. Using a hotter motor will increase the chance of stripping a gear when you punch the throttle. A mild motor will provide plenty of speed. AS

NI-CD NIGHTMARE!

Recently, I was reading the Minneapolis-Tribune, when I came upon the heading, "Nix on Nickel-Cadmium." I was shocked to read that the juice for my R/C cars

would be outlawed as of August 1, 1991. This is another problem for an already dying business/hobby in Minnesota. I'd appreciate a response to this, because I truly enjoy the hobby. For now, I'm out of juice.

Dean W. Smith
NORTHFIELD, MN

No need to fear the end, Dean. You simply misunderstood the article. As of August 1, 1991, Sanyo (and all Ni-Cd battery manufacturer) must recycle old, worn-out cells. On the labels of the new Sanyo 1400 SCR cells, there's "recycling" symbol (a triangle composed of arrows). This symbol means that old cells can no longer be

(Continued on page 10)

REEDY Modifieds

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(Graph shown represents actual computer readout of Reedy Modifieds motor.)





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LETTERS

thrown in the garbage; they must be recycled. So Dean, you can use Ni-Cd batteries to your heart's content, and as long as you recycle them, you won't be breaking any laws. AS

BEAUCOUP QUESTIONS

I have a lot of questions, and I hope you can answer all of them. Why do the front and rear dogbones in my Turbo Optima Mid SE bend? Can I fix the problem, or do I need new dogbones? Does anyone make telescoping drive shafts for my car and, if so, are they better than dogbones? My rotary speed controller is wearing out, and I want to buy an electronic controller. What should I look for to get a good ESC? I use SCR and SCE batteries and a Reedy Esprit Sport motor. What do narrow wheels and tires do for 4WD cars, and what's so special about slipper clutches? Thanks!

Pat Angell
TOPEKA, KS

Your car's suspension is probably being compressed so much that the ends of the dogbones are forced all the way into the drive cup when the suspension bottoms out. When this happens, the dogbones can't move inward any further, so they bend. Try decreasing the shock's upward travel slightly by adding O-rings to the bottom of the piston, near the bottom of the shock.

If you're looking for an affordable, high-quality speed controller, check out Novak's new 410-M5 or Tekin's new 408S. Both of them will easily handle your power requirements. As for your last two questions, narrow wheels are primarily used on 4WD cars with one-way drive systems. With this system, all four wheels are under power during acceleration, but when you let off the throttle, the front wheels spin freely, as they would on a 2WD car. Narrow wheels and tires help to reduce drag on the straights. Slipper clutches help to control the power of hot modified motors, and they reduce the wear and tear on the drive train when you punch the throttle hard. AS

MODIFIED RIDE?!

I think it's time that I tried a modified motor in my Ultima II. My friends are always saying that "this motor lasts longer than that one," or "that motor is faster than this one." Is there a difference between the brands of motors?! If so, which brand has the longest life with proper maintenance? Thanks for your help.

Byron Arant
IRVINE, CA

Well, Byron, although your friends are trying to help you, I think they're doing more harm than good. If it's properly maintained and you change its brushes and springs when they show signs of wear, a modified motor will last a long time. Any of the milder modifieds offered by the reputable manufacturers (e.g., Trinity, Reedy, Twister, B&R, Peak Performance, etc.) will fulfill your speed needs. Don't use a motor that's too powerful, though, or you might end up with stripped gears. For tips on how to maintain your modified motor, check out "Modified Motor Maintenance" in the February '91 issue. AS



ERRATA

In the September '91 issue of Car Action, we printed a letter by Kevin Frederick, and our answer implied that the Traxxas Cat is no longer being produced. Well, guess what? The Cat is still in production and doing well. If you're in the market for a good, entry-level car, check it out!

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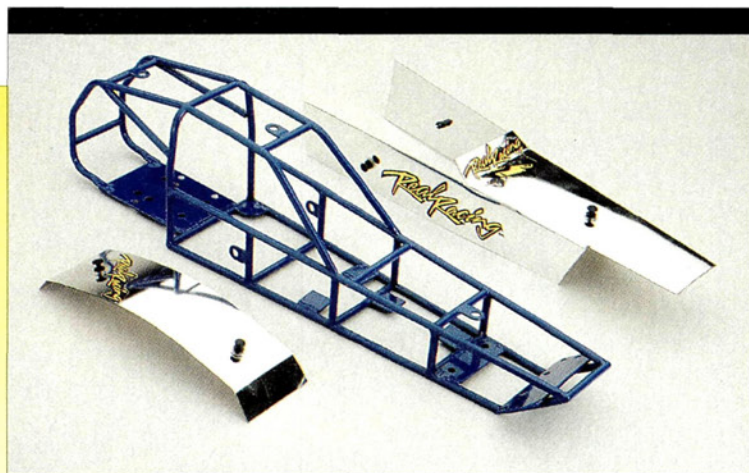
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INSIDE SCOOP



by CHRIS CHIANELLI

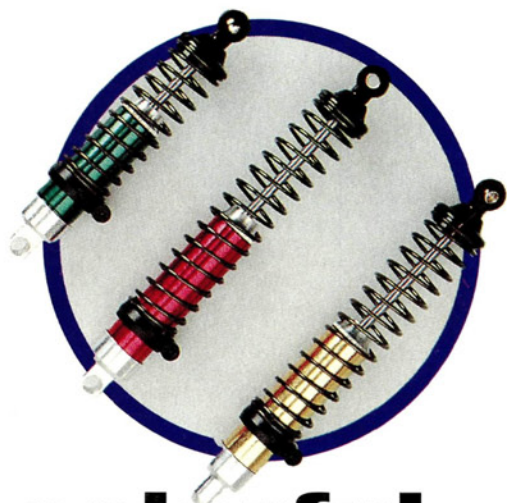
As directed by the Ayatollah of Radio Controlla, Commander Crash Chianelli reporting back to the faithful followers of the Grand High Exalted with pertinent information! I'm back from my latest espionage excursion with microfilm, spy shots and stolen communiqués that read as follows:



It's no secret that 1/10-scale buggies are extremely popular; it's also no secret that they don't look anything like full-scale buggies! Many have asked, "Why don't they make them look more like the buggies you see racing on the stadium circuit?" Well, thanks to Real Racing (P.O. Box 16867 Encino, CA 91416-6867), buggies can now look more true to scale—much more!

Real Racing's 3/16-inch-steel-tube welded frames are made in jigs to ensure trueness. The front-suspension mounting plate, the steering crank plate, the rear suspension and the transmission plates are all drilled with counter-sunk holes that will accept RC10 components. Real Racing chassis are handmade and each carries its own serial number. The thieves won't like that!

Scale Buggy



colorful Trinity

These colorful aluminum shocks should make any car or truck more eye catching—especially useful if you're trying to catch the concours judge's eye. Sets are available for the Blackfoot and Clod Buster/Bull Head, to which they can be directly bolted without the use of additional parts.

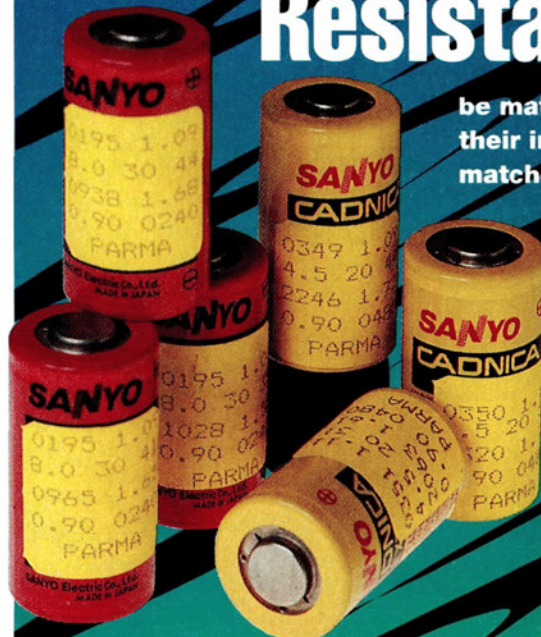
Parma's Internal Resistance

Parma's new computerized matching equipment has enabled it to produce "Final-Matched" Sanyo 1400 and 1700 SCRs and SCE cells. This system not only

allows the cells' run times and amps to

be matched, but it also allows their internal resistances to be matched. Parma is confident

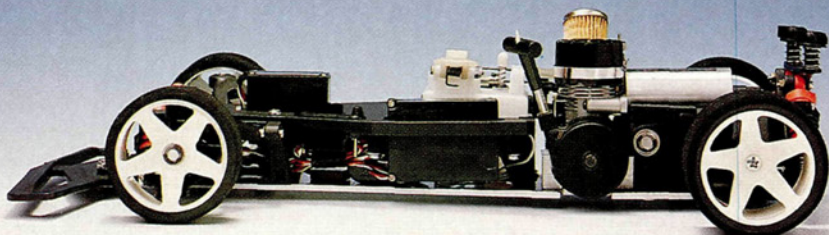
that the equipment used in the "Final-Matched" system will give R/Cers accurately matched cells for optimum performance.





sudden Impact 10

Distributed by RC Motorsports of Miami, FL, Team Serpent has introduced its 1/10-scale, gas-powered, on-road Serpent Impact 10. It comes from the factory fully assembled; just install the radio gear, fill the tank and you're ready to race. Made mostly of aluminum and injection-molded nylon, the Impact 10 comes with an installed pull-start Magnum .10 engine for which Serpent designed a special rear-exit muffler system. Its manufacturer claims that this muffler reduces noise to an extremely quiet 75dB (the distance at which this reading was obtained isn't given). The Impact 10's other features are a belt drive, a centrifugal clutch and a host of optional bodies—everything from an Audi Quattro to a stock car.



IMPROVED TOP-OF-THE-LINE KO

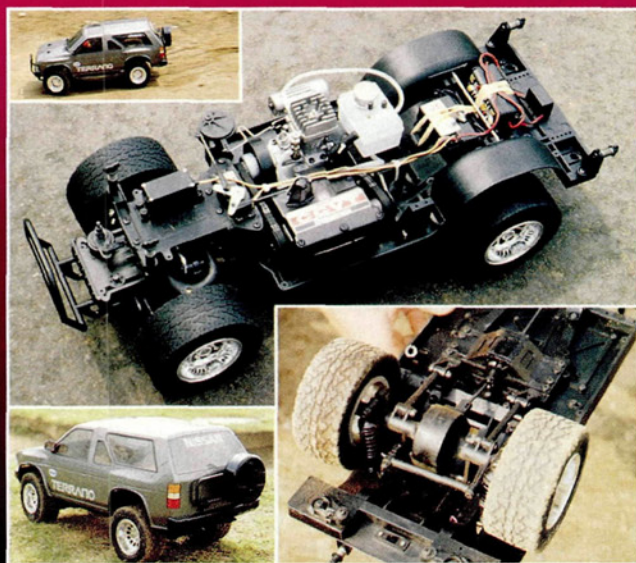


The KO EX-1, which has always been the racers' choice in KO's radio line, seems to have been upgraded. Note the inlaid green grips, which are also available in four other colors. It isn't yet clear whether the upgrades are only cosmetic, but I can tell you that the new KO PS-1001 FET servo is very powerful, accurate and has a super-fast transit time of 0.07 second! KO knock-out!

Secret Tranny Surfaces

You may remember the Kyosho/Bridgestone Compact Constantly Variable Transmission (CCVT) that was featured in the June '91 issue. Well, for those who didn't read that issue (where were you?!), it's a tranny that has an infinite number of ratios that are obtained through its expanding and contracting pulleys. Meanwhile, the engine runs at a constant speed in its optimum-torque band. Well, the

device has found its first resting place—a new Kyosho 1/9-scale 4WD Nissan Pathfinder that's powered by a pull-start O.S. .10 FP that's connected to a shaft-drive system. Very few facts are available about the Nissan but, as you can see from the photos, its front suspension has upper and lower arms, its rear is a live axle with trailing links, and the car seems to have been designed around the CCVT system.





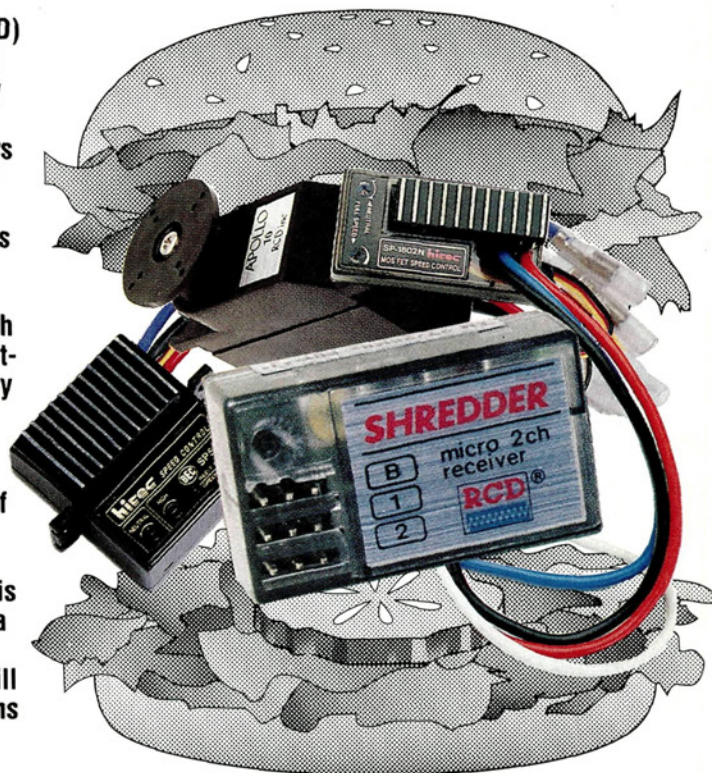
numero



Italy's 18-year-old Lamberto Collari and his reportedly stock BMT Blitz won the '91 IFMAR 1/8-scale World Champs (held in Austin, TX, on June 29 through July 8). Lamberto further secured his position as champion by also snatching the Top Qualifier slot!

Have it your way!

Radio Control Development's (RCD) Team Shredder has come up with a new marketing concept. Participating dealers will offer individual speed controllers, receivers and servos so that customers will be able to mix and match them with a particular transmitter right at the hobby shop. Not only will buyers have convenient, customized radio sets instead of pre-packaged combos, but RCD's Dave Abbey says this more efficient, "à la carte" way of offering products will mean cost reductions that will be passed on to consumers.



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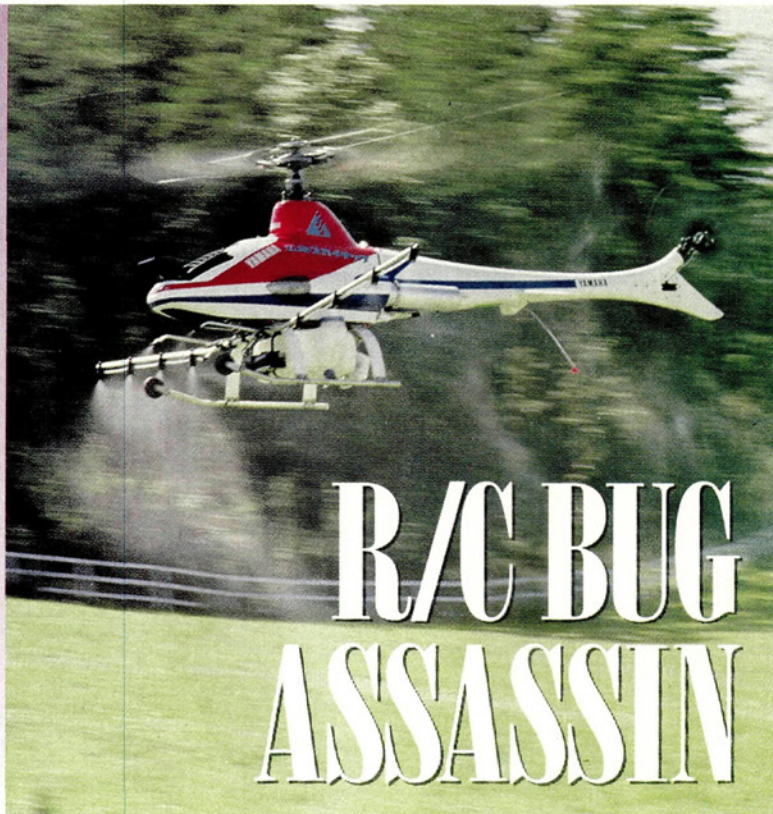
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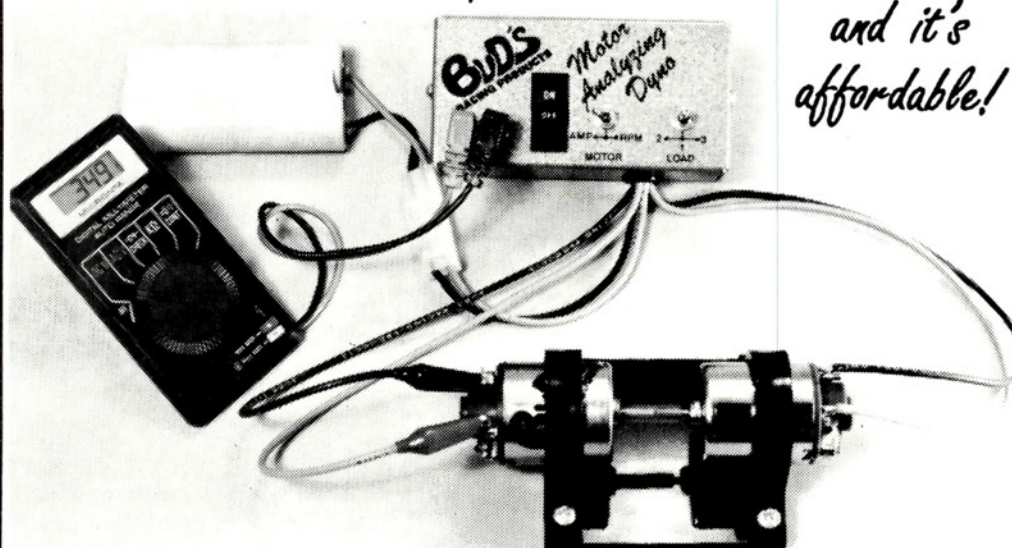
This Yamaha R-50 (it's distributed by Yamaha, but it's manufactured by Hirobo) is used for crop dusting on small Japanese farms. Powered by a 2-stroke Yamaha 98cc engine, the 96.8-pound R-50 is almost 12 feet long, and it has a main-rotor span of 9.8 feet. Crop dusting requires three operators: a pilot, a technical assistant and a wire operator who controls the flow of insecticide, which is pumped through a

hollow wire from a nearby truck to the chopper. In addition to the crop-dusting gear, the R-50 can carry a payload of up to 44 pounds, so it's often equipped with an onboard spy camera. Using her multi-faceted influence, our beautiful spy in the Far East (code name Lingafoon) has just acquired one of these contraptions for "Inside Scoop" spy shots. The R-50 isn't available in the U.S., but it should be.



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TROUBLESHOOTING

by STEVE POND

Illustrations by GERRY YARRISH

A LESSON IN PLAY AND GEARS!

I recently converted my RC10 into a stadium racing truck, and I installed a Stealth transmission. I'm happy with my modifications, but I have two problems that I can't seem to solve.

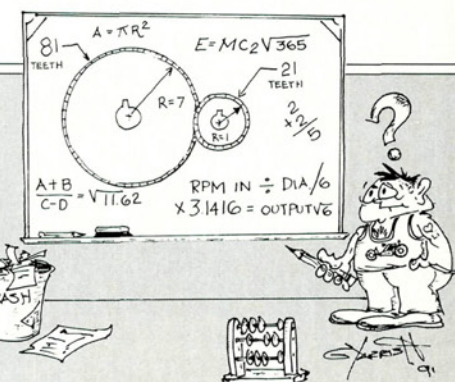
There's a lot of play in the front tires. Many of the other stadium trucks at my track have this problem, but not to the same degree. None of the play is in the bellcrank or the servo-saver; it's all in the tree. How can I limit it without causing too much friction between the axle and the bearings? (If it helps, I use JG rims).

With the change from the old transmission to the new Stealth, I'm also having problems with gear ratios. By how many teeth should I go up or down? I don't want to spend lots of

money trying to find out. (With my old transmission, I used an 81-tooth spur gear and a 21-tooth pinion gear.)

Mark Johnson
Wheatley Heights, NY

Even with ball bearings, there's reasonable amount of play. Sometimes it develops when a bearing isn't on the shaft tightly, and sometimes it occurs in the bearing itself. As bearings age and wear, the play worsens. Is this bad? No. If your truck were assembled to perfect tolerances, you'd have to race it inside a chamber with a controlled atmosphere—completely free of dust particles—because even a micron of dust would jam the bearings. Trucks use large, heavy tires, so



there's a lot of stress placed on all their bearings and suspension components. You could say that play is in the nature of the beast.

Here's the solution to your ratio problem: the old Associated tranny has an internal ratio of 1.83:1, and the Stealth has one of 2.25:1. To achieve the same final-drive ratio using an 81-tooth spur gear, you have to use a 26-tooth pinion.

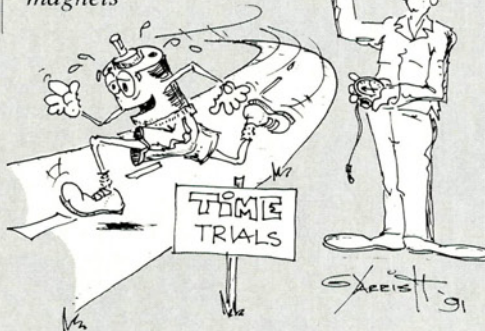
THE TIMING RUN-AROUND, AND AROUND, AND AROUND...

My question concerns modified-motor timing. I run an RC10 Graphite racing truck with a Novak MXc, a Stealth tranny and A&L rear trailing arms. I use a Losi Jr.'s Choice, a Phantom 19 Double (the older style with aluminum endbell), or an older, Reedy Gold Dot motor that I bought secondhand.

I understand that the purpose of adjustable timing has to do with efficiency (i.e., current versus rpm) and available torque, but when I ask the people at a hobby shop about it, all they do is try to sell me a dyno. Either they're too busy to talk, or they don't know the answers, so they're "covering up." Why do you alter the timing on a modified motor? How do you do it without using a dyno or "spending" several packs at a track before race time? Is there a bench-method setup using a volt/ohm/ammeter?

Boyd Ingram
Baltimore, MD

I've never been one to recommend advancing the timing on modified motors. Without going into too much detail, here's an explanation. In a motor with "zero" timing, the brushes are aligned with the centers of the magnets in the can and, when current passes through the motor, the armature segment is aligned with the centers of the magnets. The motor can take full advantage of the magnets'



strength, and though it produces slightly fewer rpm, it runs very efficiently. When current passes through a motor with, say, 45 degrees of timing, the armature segment is positioned 45 degrees beyond the centers of the magnets instead of being aligned with them. Because roughly half of each magnet is rendered useless, the magnetic pull on the armature is reduced, and this allows the motor to rev more. Experienced racers will tell you, however, that no-load rpm doesn't affect performance.

Although a motor with increased timing is advantageous on tracks where racing speeds are very constant, such motors use more current. I prefer to choose the proper motor for the application and set its timing close to zero (e.g., with 1 or 2 degrees of advancement). The motor runs more efficiently in this configuration.

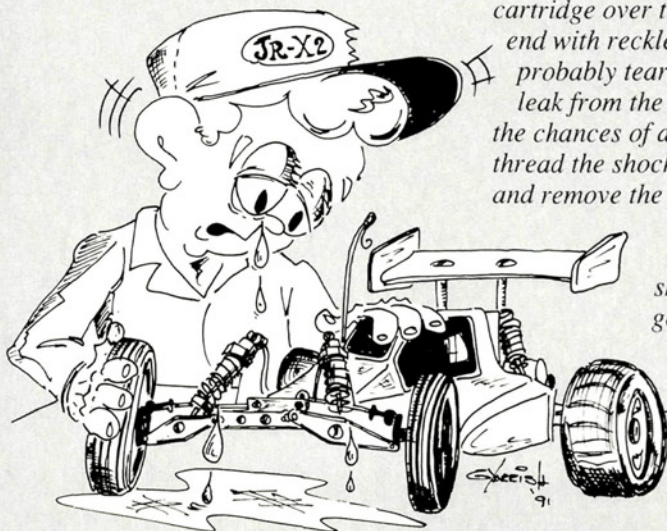
If you have a technical problem that your hobby shop or racing friends can't resolve, give us a shout at Radio Control Car Action, and we'll see if we can chase down an answer for you. Questions should be of a technical nature and should be addressed to Troubleshooting, c/o Radio Control Car Action, 251 Danbury Rd., Wilton, CT 06897.

LEAKY-SHOCK BLUES

Help! My JR-X2 shocks are leaking! It's really frustrating because RC10 owners always enjoy making fun of JR-X2 owners with problems, and they've found me! (I don't get mad; I feel sorry for them. I guess they need to console themselves because *their* cars rarely work properly! Have you ever seen an RC10 owner smile? Nope!) I bought my JR-X2 last

August, and I didn't have any problems with it until late in December when I noticed that the shocks were leaking slightly. I figured that the cartridges were worn, so I replaced them thinking that my problems were solved—no such luck! As soon as I installed the new cartridges, they began to leak. You've probably concluded that the shafts are scratched, and this has damaged the cartridge seals. Well, the shafts are scratched, but the scratches are so small that I can't see how they could possibly have damaged the seals.

The condition of the old cartridges was strange. The hole in which the shaft sits wasn't perfectly circular; it was oval, as if the shaft wasn't moving in a straight line (and no, the shafts aren't bent!). What should I do?



If there isn't a simpler solution, I plan to replace all the shocks. I'd like to use Losi shocks, but I'm concerned about the leaking problems they've had. Which brands are compatible with the JR-X2? Thanks for any help you can give me.

Scott Wilson
Terrace, B.C., Canada

There are dozens of possible causes of your shock-leaking problems. The one that seems the most likely is that you didn't clean the shocks often enough. If you let oil residue collect around the bottom of the cartridges, it will attract dirt like a magnet. The built-up dirt will then act like sandpaper on the shock shaft and the cartridge. Although small scratches on the shafts may seem harmless, they can damage the O-rings in the cartridges more quickly than you think.

The oblong hole in the shock cartridge could be the result of binding where the shock is mounted to the shock tower or to the suspension arm. Check that the shocks pivot freely at both ends.

It's also important to install the cartridges properly. If you just slide a cartridge over the shaft's threaded end with reckless abandon, you'll probably tear the seals, and they'll leak from the "get-go." To minimize the chances of damaging a cartridge, thread the shock end onto the shaft, and remove the piston. Then cover the cartridge with a liberal amount of shock oil, and slide it gently over the piston end of the shaft.

Stick with Losi shocks; they're some of the best in the business!

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TROUBLESHOOTING

OUT DA CONTROL!!!

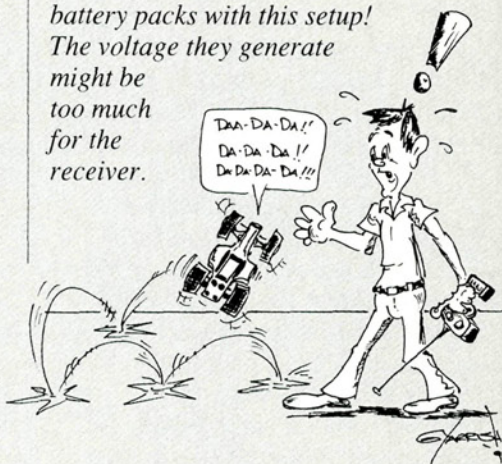
I have a JR-XT, and I use an Airtronics XL2P radio, a Novak T-1X ESC, a Mr. K motor and 6-cell Sanyo battery packs. Every time I pull the trigger, my car stutters and goes out of control. The guy at my hobby shop said that I needed capacitors, so I put them on, but they didn't help. Although my motor was brand-new, my friends said that it caused the problem. I tried a Reedy stock motor (from my RC10), and the car worked well. Can I use a modified motor in my car without having the stuttering problem?

Chris Du
Westminster, CA

The hobby shop was correct to advise you to add capacitors; you should use them whenever your car has glitching problems under acceleration. I had a similar problem with the T-1X, and it was largely the result of a deficient voltage regulator. When I used a hot modified motor, the voltage that was supplied to the receiver often dropped under acceleration. This problem was compounded when I used a 6-cell pack instead of one with seven cells. There are two simple solutions, both of

which cost little or nothing. First, try Novak's Stutter Stopper capacitor. It stores power for the receiver, and picks it up whenever the BEC voltage drops below a certain level.

The second remedy would be to increase the voltage by connecting the speed controller's jumper wires (i.e., the two that are usually connected when you use a 4-cell pack). This will increase the voltage so much that it will stay within the receiver's required voltage range even when it drops under acceleration. A few words of warning: don't use 7-cell battery packs with this setup! The voltage they generate might be too much for the receiver.



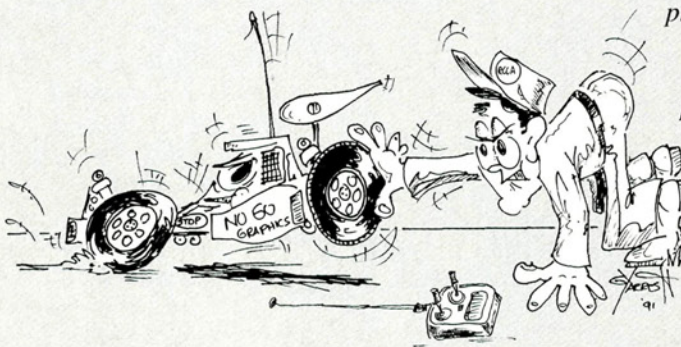
GOING NOWHERE!

When I turn on my T-4, the wheels on my Associated 12L turn for a second. When I turn the controller on, though, the steering servo doesn't move, and when I gas the car, the tires don't move. My hobby dealer says that the controller might be fried, but the light on it still works, so I don't know what to do. Can you help me?

Jason Daw
San Carlo, CA

There's a good chance that something has burned out in the speed controller. Often, a controller's light will function, and the steering servo may even move when you turn it on, but its electronics still might not be working.

I've had similar symptoms from radio-related problems. Factors that contribute to poor radio operation, e.g., a damaged crystal, weak batteries, a cut or broken antenna, might also cause the problems that you've described. If you determine that the problems are caused by a damaged speed controller, send it back to the manufacturer for repair.



READERS' RIDES

"Readers' Rides" is our way of recognizing the unique, innovative—and sometimes bizarre!—vehicles that our readers have created. Send us a sharp, uncluttered, well-exposed color photo of your car or truck (no Polaroids, please!), along with a brief description, to "Readers' Rides," R/C Car Action, 251 Danbury Rd., Wilton, CT 06897. If the Ayatollah chooses your photo, you'll receive a one-year subscription to Car Action, or an extension to your existing subscription. You'll also be eligible for the third annual "Reader's Ride of the Year Contest" in the fall of 1991. Write your address and phone number on your letter and on the back of each photo you send, in case we need to contact you.

PICTURE PERFECT

Michael Calcote of Amarillo, TX, is a professional photographer, and he wanted his car's body to reflect that. His creation is a Team Losi JR-XT with a Kodak Film body. Several mods were made under the body to allow the truck to run with the big boys: a Tekin 411P; an MIP slipper clutch; Lunsford titanium tie rods; Losi Stagger Rib front tires; and Losi X-Pattern rear tires for added grip. Michael has raced his truck seven times so far, and he has walked away with four 1st places and two 2nd places.



EVOLUTION

Tim Winters of Truro, Canada, started racing a box-stock RC10 three years ago. After many modifications, like a Stealth tranny, a Trinity motor, a Tekin 300, Losi bellcrank steering, Andy's A-arms front and rear and Pro-Line tires and wheels, this RC10 is the cream of the crop!

BRUTE FORCE

This piece of military machinery comes from Oklahoma City, OK. Randy P. Walker started with a Big Brute, and added custom shock towers; a custom trailer hitch; a LeMans 360 ST motor and a full set of Thorp gears. The real attraction isn't the chassis, but the body. It was made out of scrap balsa, and it's a semi-scale version of an AM General M998 Hummer. Other details include a rotating ring-mount for the machine gun; a full interior that includes a steering wheel, shifter, instrumentation and seating for two; and a storage rack that holds two TOW missile rounds. The trailer behind the Hummer is made out of spare Big Brute and Icarus parts, balsa and aluminum. All we can say is "Wow!"



■ TRACTOR FACTOR

This tractor-trailer combo comes from Robert Wagner's workshop in Camp Hill, PA. The tractor is a Tamiya Bullhead with a CCP chrome package, an aluminum steering package, and aluminum gear case brackets. Also on the Bullhead are 16 oil-shocks, Stormer 4:1 gear-reduction units, a Futaba 1/4-scale servo for steering and a Novak 610 RV to control the motors. The trailer is homemade from aluminum and spare parts, and its features include CCP wheels and shocks, Blackfoot tires and two Futaba 1/4-scale servos to raise and lower the ramps! Rounding out the package is a Blackfoot with CCP Chrome package, a Futaba radio, and a Novak 610 RV speed controller. All this hardware adds up to a potent package that shines with brilliancy!



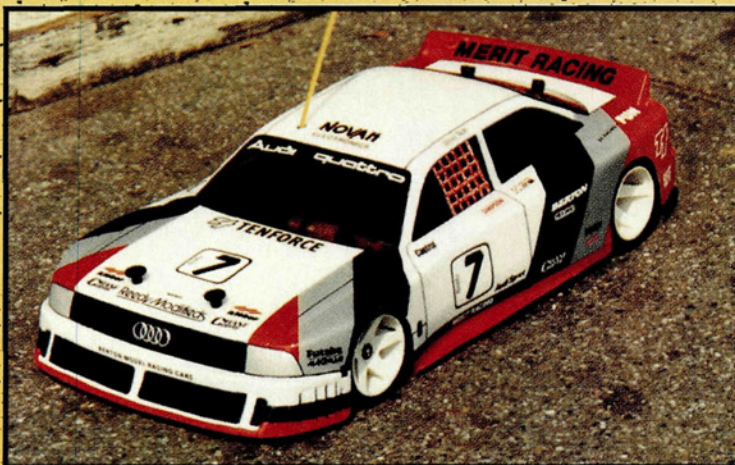
■ WE HAVE LIFT OFF!

John Hubbard (no relation to old Mother Hubbard) of Blue Jay, CA, dreams of being an airline pilot, but alas, he has only his R/C cars to race. To make his JR-X2 fly like an eagle, John added the Jonger Losi graphite chassis for more stable flights, a Trinity Monster Jam stock motor, a Novak Speed controller for better liftoff speed and a Novak Mini Receiver for better mid-air control. The only thing missing is a set of ailerons!



■ STREET ROD

Paul Meyer of St. Louis, MO, sent us this photo of his street rod. An RC10L Super Speedway with a Futaba radio and speed controller, and a Trinity Nuclear Assault motor are under the body. Paul custom-made a set of street rims so that he could use 2-inch-wide sprint rear tires, and two ZR-1 tires up front. To top it all off, Paul added a 1969 Chevy Chevelle body.



■ DUTCH TREAT

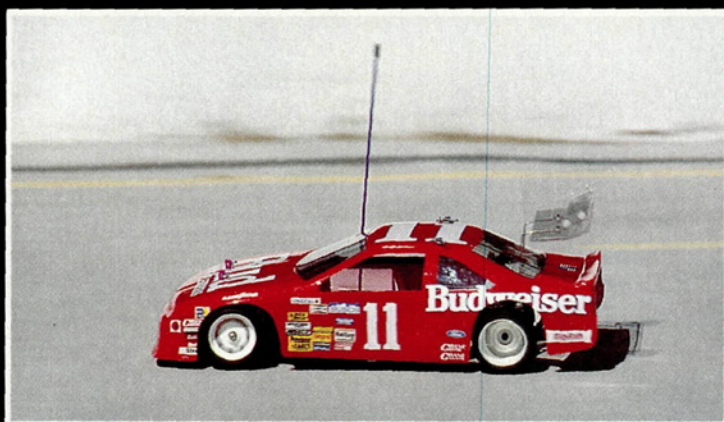
This scale-looking Berton TenForce comes from Rob Adelaar in the Netherlands. Because he wanted a scale-looking car, Rob topped the already potent chassis with an Andy's IMSA Audi 90 Quattro body. He also added a Corally-Digital Motor-Management System II; an Airtronics 94141 Super servo; a Futaba Megatech PCM (Magnum PCM) radio; and a Trinity 18-turn double motor. Finishing touches include Tamiya scale decals and a paint job that resembles the full-size race car.

SOMEWHERE ALONG the way, I decided to take the road less traveled. I don't know why, but I've always been a champion of the underdog. While everyone else on the full-size car racing circuit drove Chevys or Fords, I drove a Chrysler. I've always felt bad for the coyote in Looney Tunes, and I prefer Bugs Bunny to Mickey Mouse and Hardee's to McDonald's. When I started racing R/C cars, instead of buying one of the cars that were popular at my local track, e.g., Associated 10Ls or TRC Lynxs, I bought a Bolink, and I was successful with it. At my local "super" track, however, the Bolink developed a "hiccup." The car that had worked so well on carpet didn't work on this concrete tri-oval track, and I had to find a car that did.

Now, any sane man would buy one of the *successful* cars (notice that I said "sane"!), but that's not what I wanted to do. When I raced Chrysler cars, I always said that anyone could make a Chevy run, but it takes a mechanic to make a Chrysler run. I applied this theory to R/C car racing—enter the PB* Sizzler.

euro-THRASHER

PB



by LARRY COLE

SPECIFICATIONS

Type	On-road
Scale	1/10
Price	\$299.95

DIMENSIONS:

Overall Length	12.375 inches
Width	9.5 inches
Wheelbase	10.75 inches
Front Track	8.625 inches
Rear Track	9.5 inches

WEIGHT:

Gross (with battery)	2 pounds, 8 ounces
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BODY:

Type	Not included
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CHASSIS:

Type	Pan
Material	Composite fiberglass

DRIVE TRAIN:

Primary	Pinion/spur
Transmission	Direct drive
Differential	Ball
Bearings/Bushings	Ball bearings

SUSPENSION:

Front: Type	Floating kingpin
Damping	Front coil-springs
Rear: Type	Five-point, full-floating rear pod
Damping	Oil-filled shock

WHEELS:

Front: Type	One-piece plastic
Dimensions (DxW)	1.938x1.25 inches
Rear: Type	One-piece plastic
Dimensions (DxW)	1.938x2 inches

TIRES:

Front/Rear	Special compound foam
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ELECTRICS:

Motor	540/05*
Battery	6- or 7-cell saddle pack*
Speed Controller	Not included

OPTIONS AS TESTED:

Futaba Magnum Jr. radio and S148 servo; Novak T-4 ESC; MaxCell 1400 SCR saddle packs; B&R Bullet motor; Bud's* Bi-Level Wing and decals; Bolink front steering blocks and adjustable steering rods; Du-Mor spur gear; Lightning Rod* Memory Mount Body Posts; TRC* T/M Radials; MRP Thunderbird body and Concours interior.

COMMENTS:

The Sizzler is for serious racers. Although it's a "metric" English import, it can accept many common U.S. parts, e.g., bearings that aren't metric. An LTO-type chassis is in the works. This car isn't as narrow a many of the new on-road cars, but its wider stance makes it more stable.

* not included

The Sizzler is an English import that's distributed by PB Sales and Racing. Owner Jim Meach was more than happy to discuss this car with me on the phone, and he convinced me to try it. The Sizzler has a straight-axle, graphite front end, and it's advertised as being the first car to use an independent rear end with a five-point rear system.

Since its first appearance on the market, the Sizzler has undergone major changes. If you're familiar with the earlier version, don't use it to make judgments on the new one; you'd be doing yourself—and the car—a grave disservice. (A conversion kit is available, so you can update the earlier version of the Sizzler.)

The updated Sizzler's rear shock now travels vertically instead of from front to back, and to make it "ROAR legal," the car's rear end has been narrowed. The Sizzler is made of a combination of graphite composite and aircraft-grade aluminum, and it has ball bearings throughout and a "proto-type" diff.

FIRST THINGS FIRST

When I received the car, the first thing I did was open the box to see what tools I'd need for assembly. There's nothing worse than being halfway through a project only to discover that you need a tool you don't have! The instructions include a separate list of necessary tools (the car is "metric," so this is definitely helpful), but I think

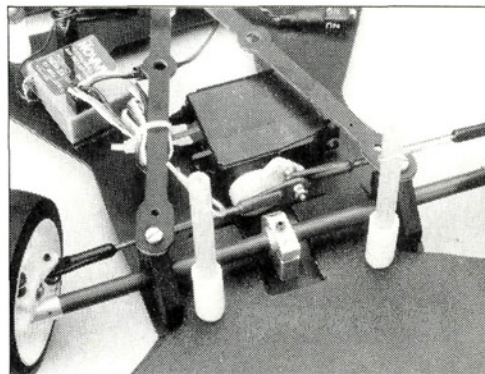
the instruction sheet has to go! If I hadn't had experience building R/C cars, I would have been totally lost! There's a main instruction sheet, a supplementary sheet, a supplementary letter and, well, I think you get the drift. Thank goodness for the pictures! (I did say that I wanted a car

that would challenge

the mechanic in me, didn't I?) I've been told that a new instruction sheet is being written. Let's hope that it will make assembly a lot easier!

Even with improved instructions, though, this car wouldn't be for beginners. It's designed to race, and the skills you need to assemble it confirm this.

The best advice I can give is that you should take your time, follow the instructions as

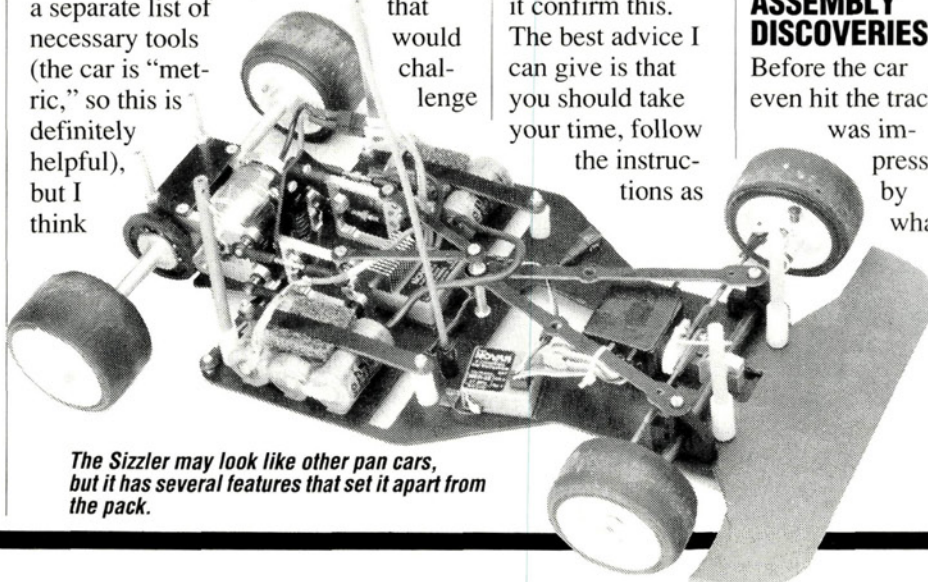


well as you can, and use your common sense.

Only one cinch block and two carriers hold the car's front axle in place.

ASSEMBLY DISCOVERIES

Before the car even hit the track, I was impressed by what I



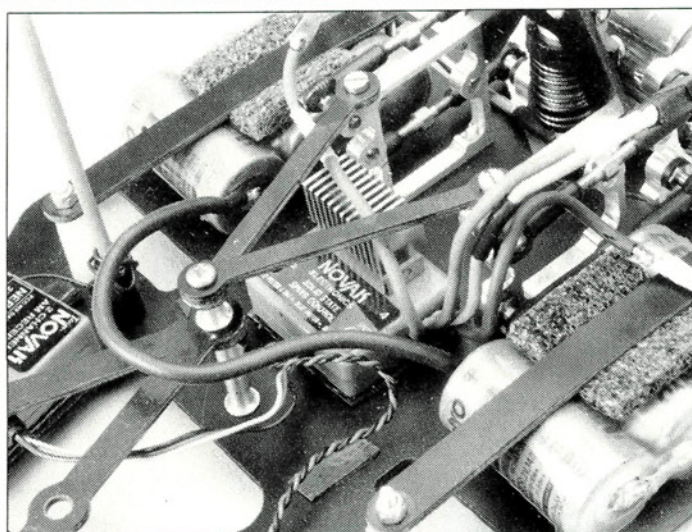
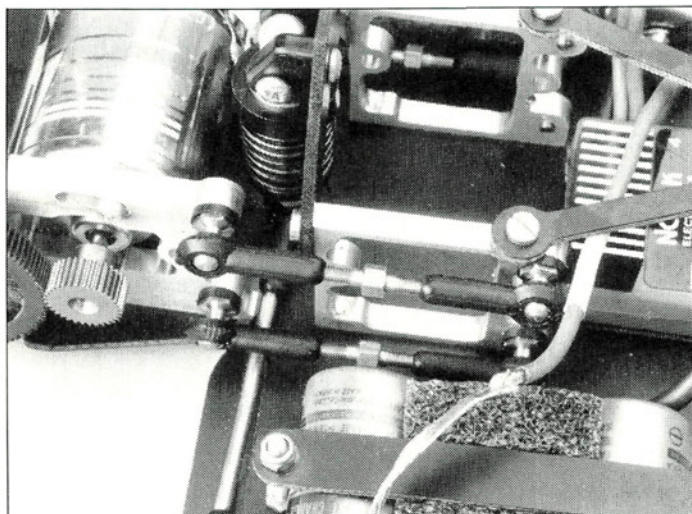
The Sizzler may look like other pan cars, but it has several features that set it apart from the pack.

saw. The five-point rear suspension has two radius rods on each side with a panhard bar as a centering device, so you can make many fine-tuning adjustments. I also noticed that the configuration of the cross-braces (i.e., the chassis' upper "plate") is similar to that of a roll cage on a full-size NASCAR car. To prevent the chas-

found on the cage in a full-size NASCAR car), and they run to the front and the rear from the center. On a full-size car, the brace that runs to the right front is called a Grand National wedge bar, and it's interesting to see this concept applied to an R/C car.

Unlike many foreign cars, the Sizzler can accept standard, readily

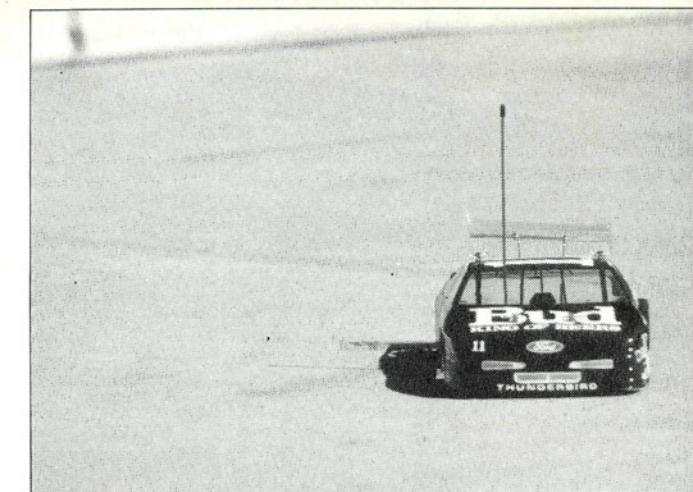
The Sizzler's five-point rear suspension has a vertical, oil-filled shock.



These cross-braces prevent the chassis from flexing and force the suspension to do the damping.

sis from flexing, the braces are mounted in the center of the car (they form an "X" similar to that

available components. I chose Bolink* steering blocks and kingpins on the front end and a standard



Du-Mor* spur gear. (The diff rings on the Sizzler are smaller, so I just used the inner ball holes.) To use standard NASCAR wheels, I drilled out the wheel-bolt holes to make them one size larger. The rear axle has standard bearings, and the car doesn't need longer pinion gears.

When I had finished assembling the car, I stepped back and looked at it with mixed emotions. It's wider than most, but this didn't bother me. Narrowing R/C cars is the newest, hottest trend. The logic behind it is that they're more aerodynamic and, therefore, faster. I think that the wider a car is, the more stable it is. (Have you ever wondered why most R/C car associations, including ROAR, have regulations specifying maximum width but not minimum width?) Although narrow cars are faster on the straights, look out when they

have to make tight turns on flat tracks! (Some of you "old-timers" might remember the commercial for the Wide Track Pontiac.) What bothered me about the Sizzler was that it looked as if it weighed a ton! Only the scale would say for sure—later!

GET YOUR GEAR AND GO!

During the motor and the radio gear installation, I discovered the first thing about the Sizzler that I didn't like. The opening in the left-side motor plate didn't give the motor enough clearance, and this could have easily caused the motor to short. Off came the rear axle and the bearings, and out came my grinder! I ground as much as I could off the plate, replaced the rear end and re-installed the motor. Although the motor fits snugly, it has plenty of clearance.

For the car's first run, I chose a B&R* Bullet 27-

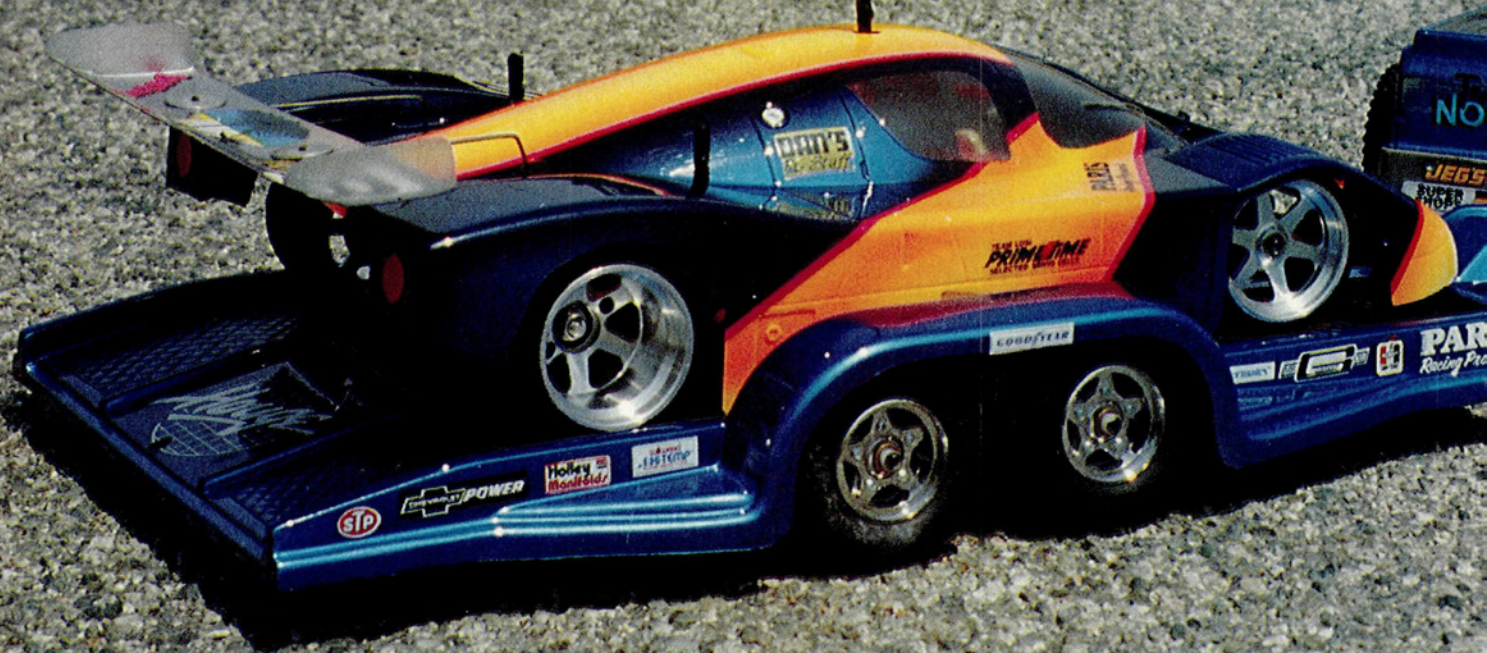
turn stock motor (I never use a modified for a new car's first run unless I'm suffering from some strange disease, i.e., "brain fade.") I used a Futaba* 148 servo because I didn't have a 132 servo, and I installed a Novak* receiver and a Tekin* speed controller. I covered the chassis with an MRP* Thunderbird body, and then it was off to the track for a practice session!

TESTS AND TROUBLE-SHOOTING

It didn't take long to find out that the Sizzler had a major problem! I ran the first few laps cautiously, and then I decided to open it up. Everything was fine until I came up on a slower car. Although I wasn't used to driving the Sizzler, I did what any normal person would do: I tried to go around the other car at full

(Continued on page 46)

HOME-BUILT PROJECT:



PHOTOS BY MIKE LEE & YAMIL SUEDE

THERE ARE MANY ways in which you can leave your mark on the world: Donald Trump used money and influence; Mike Tyson punched his way to the top; and Carlo Bruno, of Fontana, CA, left his mark by wowing everyone at the 1990 Trinity Sportsman's Cup race at Ranch Pit Stop.

What did Carlo do? He didn't pass them on the straights; he didn't drill them in the corners; in fact, he didn't have to run

his car at all! Carlo came up with a beautiful concours-winning car body that was paraded in front of the crowd on an equally gorgeous trailer that was pulled by its own custom truck.

A gimmick, you say? Maybe so, but it was enough not only to impress the concours judges, but also to attract the attention of his honor, the Ayatollah of Radio Controllah! At his beckoning, the storm troopers of the West descended

upon the house of Carlo Bruno to bring you, the dedicated readers of *Car Action*, a close-up of this special combination.

The winning car is based on a Sauber Mercedes C-11 Group C body from Andy's R/C Products*. The body was painted by the Andy's people, but Carlo deserves the credit for the interior detailing and the fine exterior details. The interior is completely hand-painted, right down to the instrument numbers on the dials.

Carlo
Bruno's

CONCOURS



by MIKE LEE



To make his concours-winning combination, Carlo started with an Andy's Sauber Mercedes Group C body. The body itself was painted by Andy's, but Carlo painted all the fine exterior details and the incredibly detailed custom interior.



The Mercedes chassis (an Associated RC10L) rests on a Parma trailer (also custom-painted by Carlo). The job of hauling the trailer around falls to a TMS chassis that's covered by a TMS Chevy 6-Pak pickup body, on which Carlo worked more painting magic.

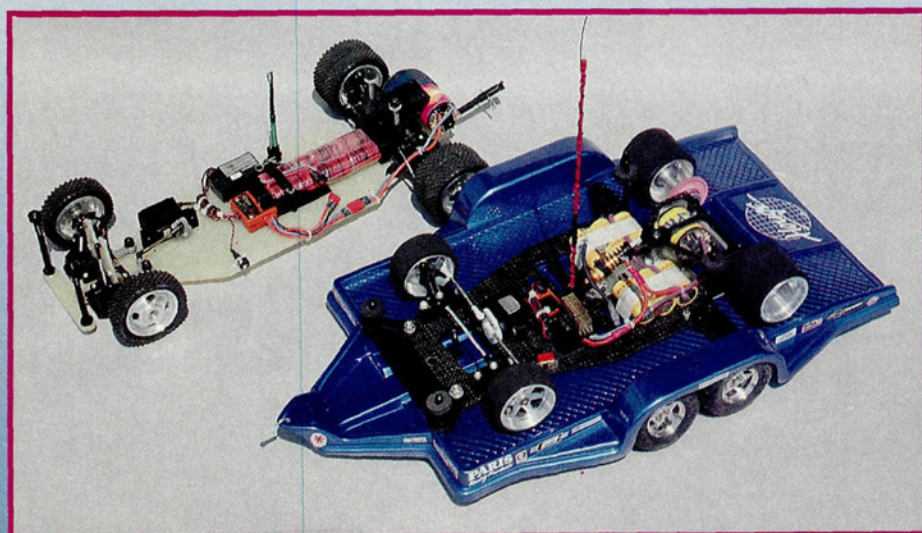
The body sits atop an Associated* RC10L Graphite that rolls on TMS* custom rims. It's powered by a Twister* modified motor and controlled by a Tekin* 411P and a Novak* micro-receiver. An Airtronics* transmitter gives commands. As far as the chassis components go, the car is basically stock, with the addition of a threaded front cross-rod for camber adjustment and a floating rear damper plate.

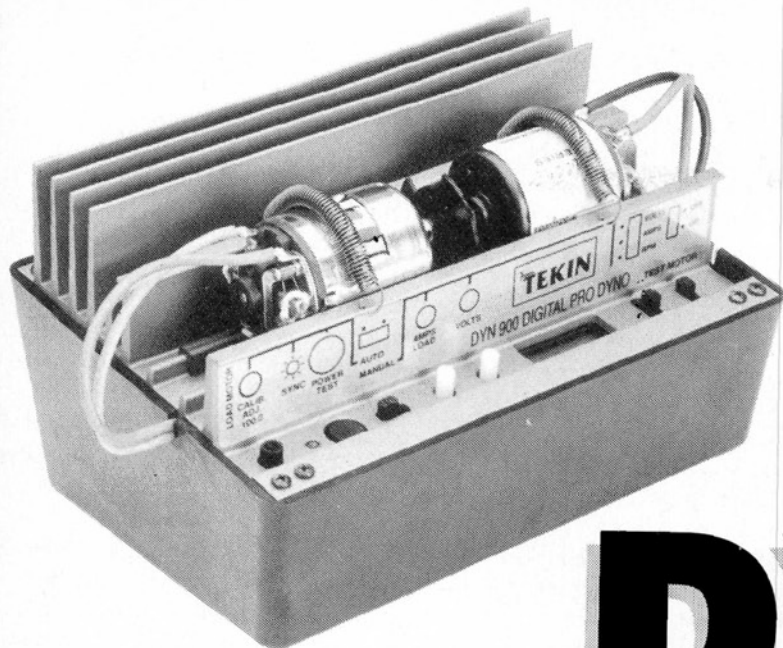
The Mercedes was seen resting on top of a Parma* trailer that Carlo had set up with TMS rims and Parma tires. Carlo did the paint jobs on the trailer and the custom hitch. To keep the Mercedes in place, Carlo installed a single 1/4-20 bolt that comes up through the bottom of the trailer and mates with a hole in the front of the RC10L chassis. With that bolt poking through the chassis, only a major bump could shake the car off the trailer.

TWISTER-POWERED TOWING

A Twister Pocket Rocket-powered TMS chassis topped by a TMS Chevy 6-Pak truck body (which Carlo also painted) pulls the car and trailer. TMS rims adorn the truck, which, like the 10L, uses an

(Continued on page 66)





by FRANK MASI

TEKIN PRO DYNO

BEING A COMPETITIVE R/C racer is tough business. Staying one step ahead of the other guy is even tougher. Racing has so many variables that it can sometimes overwhelm even the most experienced competitor. Certain aspects are controllable and can therefore be changed by the racer: chassis tuning; tires; type of electronic equipment; and, most especially, driving ability. For years, it has been the "unknown quantity" of R/C racing that has seemed to cause the most controversy and headaches among the serious. Of course, I'm talking about motors and batteries.

Recently, a flood of battery-matching and analyzing equipment has become available to consumers, and this has effectively removed much of the "mysterious shroud" surrounding the Ni-Cd battery. Racers no longer have to rely on the manufacturers to grade and match batteries. With the battery issue addressed and dealt with, manufacturers are now turning their attention toward the motor.

THE YEAR OF THE DYNO

I'll always think of 1991 as the year of the dyno. Last year, it seemed that only factory teams had dynamometers. This year, however, you don't have to look very hard to find a dyno for your very own; in fact, you can now choose from several. The very latest "affordable" (a

subjective term) dyno is the new Tekin* DYN 900 Pro Dyno. With a retail price of \$345, the Tekin Pro Dyno may be too expensive for average racers, but for those of you who feel that the difference between the B-Main and the A-Main lies solely in your motor's performance, the Pro Dyno should be just what you need.

HARNESS YOUR HORSEPOWER

Before I detail the Pro Dyno's many features, I'll explain what a dynamometer is and what it can do for your car's performance.

Basically, a dyno (as applied to R/C electric motors) measures certain characteristics of a given motor, including, but not limited to, rpm, amp draw and acceleration properties. A dyno applies a given amount of power to an electric motor and then determines how much of that power is lost through the motor's

operation at a set voltage. This determines a motor's overall efficiency. To chart a motor's rpm, most dynos have optical sensors that read the rotations of a pickup that's attached to the test motor's output shaft. Additionally, a simple ammeter is usually integrated into a dyno's internal workings to give the user an accurate reading of the motor's amp draw.

To accurately rate a motor's performance in "real world" situations, load must be applied while it's on the dyno. The problem with the so-called "motor testers" that find their way into many hapless racers' toolboxes is that they use a no-load method of performance testing. Information given without load applied is next to useless.

While I'm on this subject: I've heard many people boast about their motor's performance by quoting the maximum rpm figure given by the manufacturer. Take it from me, this means very little.

Rpm actually have next to nothing to do with a given motor's track performance: what *does* matter is the motor's overall efficiency and power. A true dyno will apply load to your motor and then give an accurate reading of its output. To achieve this load, most dynos use a second motor in addition to the motor being tested. This "slave" motor is attached to the test motor by its output shaft and, as power is applied to the test motor, the slave motor offers resistance.

PRO DYNO

To simulate the actual conditions in which the test motor will be operated, a quality dyno will electronically vary the load that the slave motor places on the test motor. For example, when you accelerate your car from a dead stop, the motor may be drawing somewhere between 20 and 30 amps, so it would be useful to know exactly how your motor performs at a 30A load. On the other hand, a car traveling down a long straight might be drawing only 10 amps; again, knowing how your motor will perform at this 10A draw will help you to determine the optimum gear ratio for a particular track.

The Tekin Pro Dyno will provide an output reading in the form of an overall power measurement (the motor's torque multiplied by its rpm). This power read-

ing will be your most important tool in determining which motors are desirable for certain conditions and which aren't. In addition to the power rating, the Pro Dyno also gives an accurate measurement of amp draw and rpm—with load and without—and provides a manual setting that allows you to measure rpm loads up to 20 amps.

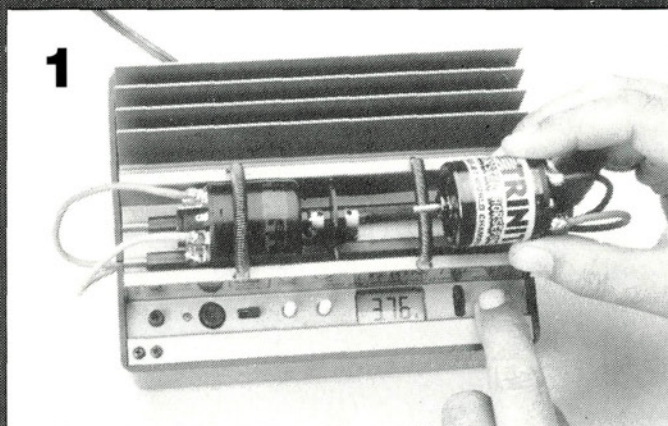
The Tekin Pro Dyno is a very straightforward, purposeful-looking device. When you look at the Pro Dyno, you get the feeling that this isn't just another "bells-and-whistles," useless accessory, but rather a precise instrument.

The Pro Dyno's top section is a large, gold-anodized, extruded-aluminum heat sink. The function controls and the dyno's LCD display are on the front part of the heat sink. The track for the test motor and the slave motor is just behind the control panel, which is separated

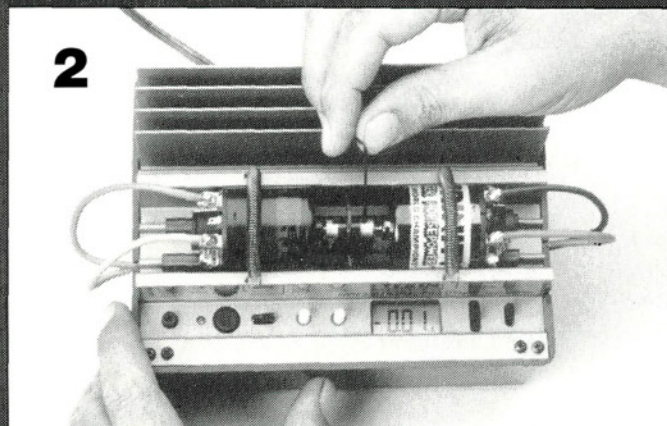
from the motors by one of the heat sink's cooling fins.

SLAVING AWAY!

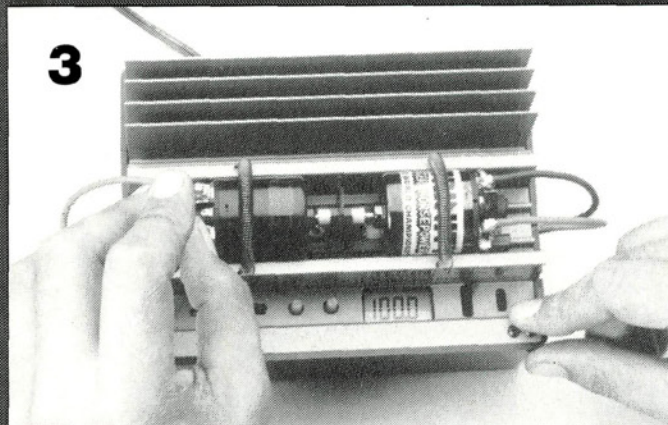
The first order of business when you operate the Tekin Pro Dyno is to find a slave motor that meets the requirements outlined in its instruction manual. The ideal "slave" motor has a stock 27- or 28-turn armature (this is necessary to provide sufficient load when you test stock motors, and it also works well with the modifieds). Additionally, use of both the can and the endbell assembly of a modified motor is recommended. Because the slave motor will be operating in reverse rotation, its timing must be set to zero degrees, and this can only be obtained with a modified motor's adjustable endbell. Finally, Tekin recommends the use of full brushes (uncut) in the slave motor, and light-to-medium brush springs. If the necessary construction



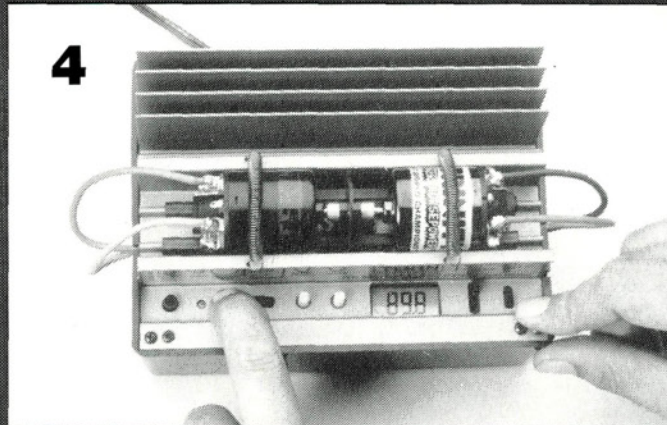
1 With the dyno ready to go and the slave motor properly hooked up, the first reading will be the no-load amp draw. This tells you how efficient your motor is.



2 For the next reading, attach the test motor to the slave motor by means of the tachometer coupling. Set the dyno on "manual," turn the unit on and set the voltage to 5. Then, switch the dyno to read rpm, and note the reading.



3 To get a power reading, set the dyno to "automatic." Turn the calibration potentiometer until the LCD display reads approximately 100. (Actually, a read-out of anywhere between 100.00 and 100.99 is acceptable.)



4 If everything is working properly, the red LED sync light will come on. Depress the "test" button and hold it down for approximately 3 seconds. The display will then show your power reading. Calculate the average of three tests for the most accuracy.

components aren't available to you, Tekin offers a pre-built, tested slave motor (no. DRP 003; retail price: \$80).

When the slave motor is ready, "set-screw" the motor coupling (with the optical rpm pickup attached) to the slave motor's output shaft, and put the slave motor on the left side of the Pro Dyno's motor track.

An important note here: it's absolutely essential that you secure the slave motor to the dyno with double-sided tape, as it must be rigidly mounted for you to obtain accurate readings. Here's the best method that I've found for doing this: cut two strips of 1x1/4-inch double-sided tape; leave the protective backing on one side of each piece; and attach them to the sides of the cooling fins on the slave motor side, flush with the tops of the fins. Peel away just one corner of the backing, and fold it so that it points straight up. Then install the slave motor with the tachometer pickup attached.

When the slave motor is in place and the pickup is properly aligned, remove the rest of the tape's backing with a pair of small pliers. The slave motor should now be firmly held in place.

After that, you only have to attach the retaining spring that also holds the slave motor (extra insurance). An identical spring is also used to secure the test motor.

POWER TO THE PEOPLE

I made one slight modification to the Pro Dyno. The lead wires that protrude from it (one set for the test motor, the other for the slave motor) have alligator clips on their ends to facilitate motor connection. I felt that the wires should be soldered directly to their respective motors for the most accurate readings. Conditions may not permit this (no trackside power for soldering irons), but you may want to at least solder the slave motor's leads and leave the alligator clips for the test motor.

After I had dispensed with these formalities, it was time to see whether the Pro Dyno would live up to its manufacturer's claims. I selected a fairly new 17-turn quad motor, put it on the

dyno's motor track, and attached it to the slave motor's output shaft by means of the tachometer pickup. Make sure that the test motor's power switch is turned off and that the dyno's power leads are connected to the power source (in this case, a 12V car battery). With the Pro Dyno set to "manual," I switched on the test motor and slowly turned the volt potentiometer up to its 5V ceiling (following the instructions). At this point, the test motor shouldn't slow down *at all*. If it does, the slave motor has been hooked up in reverse, and this must be corrected immediately.

***It was time
to see whether
the Pro Dyno
would live up to its
manufacturer's
claims.***

The Pro Dyno provides you with three separate measurements for comparison: a power reading, an rpm rating and a no-load amp-draw reading.

With the motor running at 5 volts, switch the dyno to "automatic." The motor should gradually slow as load is applied. Using the

calibration potentiometer on the extreme left of the control panel, manually set the LCD so that it reads approximately 100.0. If everything is working correctly, the small LED "sync" light will come on. Hold the power test button down for a few seconds (and only a few seconds!), and the LCD reading will change. This is your motor's power reading—the amount of power used to operate the motor subtracted from the power the dyno is applying to it. This is the most important reading given by the Pro Dyno. The higher the power reading, the quicker the motor's acceleration property will be. To ensure accuracy, you might have to take several power readings. The Tekin people think that the third reading will usually be the most accurate. Always make sure that the display reads 100.0 before you take a power reading.

FIRST RATE

To obtain an rpm rating, switch the dyno back to "manual" and, with the motor running at 5 volts, set the LCD display to "rpm." The reading shown is rpm x 1,000. As I stated before, the rpm of a given motor has very little bearing on its

(Continued on page 78)

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SCOPING OUT

by JOHN RIST

Novak 410-M5 Sport

IT'S AN AFFORDABLE, rugged, electronic speed controller (ESC) that performs well, and Novak's T4 has set the standard for the industry. Now, however, it's taking a back seat to Novak's newest rising star—the 410-M5. Novak says, "T4 + M1c = 410-M5," which might lead you to believe that the new Novak 410-M5 sport model has all the advantages of the old T4 sport model plus a lot of the advantages of the hot new 410-M1c (professional model) while "sporting" a sport-model price.

With this in mind, I took a good hard look at the 410-M5 and found that it's a

forward-only-with-brake racing style ESC.

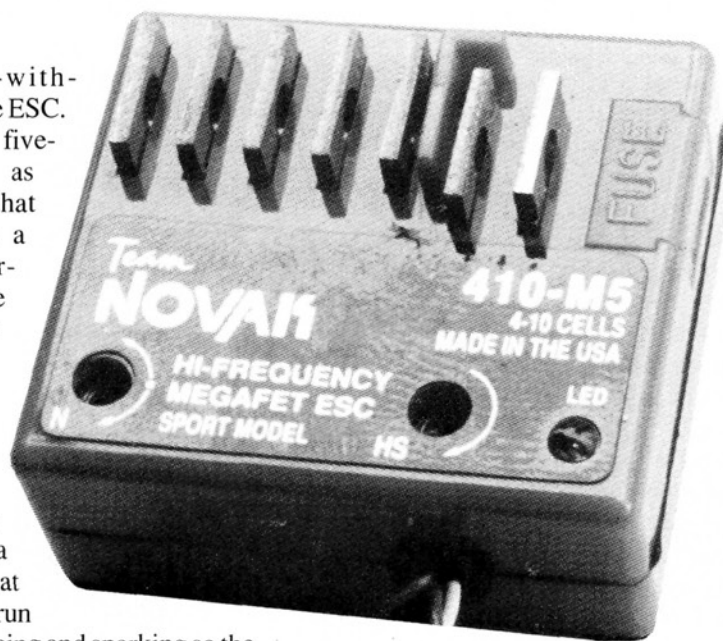
It has the same five-Megafet setup as the M1c, and that should make it a "mega-hot" performer. Also, the 410-M5 has high-frequency motor control that permits smooth throttle response throughout the throttle range, a recharge diode that

leads to longer run times, and less arcing and sparking so the armature and brushes last longer. The 410-M5 features:

- five Megafets for forward, one for brake
 - built-in BEC
 - built-in pulse checker
 - Tamiya-style battery connector and Associated-style motor connector
 - neutral and full-speed control potentiometers
 - high-frequency motor control
 - reverse-voltage battery protection provided by user-repairable fuse
 - automatic thermal protection
 - interchangeable input plug system
- The 410-M5 comes with an instruction manual, heat sinks, a screwdriver, adjustment-hole plugs, mounting tape and a hot set of decals.

BLOWIN' THE LID OFF THIS THING!

The 410-M5's case is quite easy to open: just take four screws out of the bottom, and pull the case halves apart. I was surprised to find that Novak uses the same space-age technology on the 410-M5 sport as they use in the M1c and the MXc pro models. This is probably because, with today's high-speed assembly



techniques, it's cheaper to keep the models as much alike as possible. The other force that keeps all the Novak models looking alike is the very high cost of developing a custom integrated circuit. It makes good sense to design a chip properly and then use it in all your models. Anyway, the 410-M5 has enough high-technology printed-circuit boards and surface-mounted components to have come out of a Patriot missile.

Having looked inside the controller and noted its strong resemblance to the M1c, I checked the instruction book to see what Novak had to say about this ESC's performance. In a side-by-side comparison, Novak lists the same current and resistance ratings for 410-M5 as for the M5 and the M1c. Could it be that someone has come out with a sport-model controller that has the guts of a pro model? I headed off to the "Scoping Out" lab to run my own set of numbers and to see whether this controller would live up to Novak's claims.

RESISTANCE TEST

I measure resistance twice: first, along the full length of the motor wires and battery wires (including connectors) to

• THE SCOPING OUT LAB •

John Rist's lab consists of:

- an oscilloscope
- a digital voltmeter
- a resistor load bank
- a 6V 30A electricity supply
- a Pit Stop Radio servo/speed controller tester.

The oscilloscope is used to monitor the controller's output and to guarantee that it's fully on.

The digital voltmeter takes all the voltage-drop readings and verifies the reading on the current meter.

The resistor load bank consists of 40, 12-ohm, 5W power resistors, which can be switched on and off one at a time to vary the load between .6 amp and 20 amps, but the standard 12 amps are usually used.

In series with the resistors is a 25A Simpson current meter and a 1-percent .01-ohm resistor. By measuring the voltage drop across this resistor, the current-meter's reading can be double-checked. Of course, the lab power supply provides the test current.

measure the stock ESC's resistance; second, 2 inches along the battery and motor wires to obtain a standard reading with which I compare controllers.

To test an ESC, you first have to make it operate. The 410-M5 was new to me, so I read the instruction manual from cover to cover to make sure that I wouldn't destroy it because of ignorance. The manual is one of the best in the industry. It has an excellent drawing that shows how to connect the 410-M5 with the motor, the battery and the receiver. It also gives detailed instructions on how to install the right receiver plug, and it describes the correct setup of all the popular transmitters. The 410-M5 comes with the battery and motor connectors installed, so it's very easy to install. The neutral and full-speed adjustments were standard, and the built-in pulse-checking LED was right on the money.

It's difficult to measure an ESC's resistance directly, so I measure the voltage drop across it while I pass 12 amps of current through it. I then calculate resistance using this formula: voltage divided by current equals resistance. With 12 amps of current flowing, I measured a 0.27V drop in voltage between the motor and battery connectors—a resistance of 0.0225 ohm.

Two inches along the wires, the drop in voltage was 0.07 volt—0.0058 ohm. This brings up a couple of interesting points:

- First, the connector-to-connector voltage drop is almost four times greater than that obtained 2 inches along the wires. As I've written many times, long wires and Tamiya-style connectors kill the performance of a good controller.
- Second, the measured resistance 2 inches along the wires is within a fraction of an ohm of being the same as that of the 410-M1c—0.0050 ohm (see "Scoping Out," September '91). The

(Continued on page 44)

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410-M5's slightly thinner wires account for its higher resistance.

LET-IT-COOK TEST

For this test, I install the heat sink, but I don't provide any cooling air. I found that the heat sink fit loosely and was in danger of falling off, so I followed the instructions and bent the two outermost fins inward slightly, and that solved the problem.

With the 410-M5's impressively low resistance, I thought it would pass this test easily, so I jacked the current up to 21 amps and sat back for 15 minutes while I waited for the smoke to roll.

After 15 minutes, I checked the heat sink and found that the 410-M5 was quite warm, but by no means hot enough to be hurting. Next, I felt the battery connector, which was so hot that it burned my finger! Score one point for the speed controller and a big fat zero for the connectors.

DEAD-SHORT TEST

In this test, I try to force the controller into thermal shutdown. I run a piece of monster wire rigged with two alligator clips across the motor leads to simulate a stuck gear or fried motor. The current jumped to 40 amps, and I let the test run for 2 minutes, after which the controller was smoking hot but hadn't gone into thermal shutdown. Through all this torture, the 410-M5 never missed a beat, so it should be tough enough to survive the dumb things to which it might be subjected in the heat and excitement of racing.

CONNECT-THE-BATTERY -BACKWARD TEST

I usually try not to connect the battery pack backward but, according to Novak, the 410-M5 has something called a "Solder Pop Fuse" that's supposed to protect it against reversed battery voltage. The idea behind it is that the heavy current caused by the reversed voltage will melt the solder off a little wire link that's behind a panel labeled "fuse." After fixing the reversed-battery problem, you can solder the wires together again and the 410-M5 will again operate normally.

NOVAK 410-M5 SPORT

DIMENSIONS:

Height	0.75 inch
Width	1.4 inches
Length	1.58 inches
Weight with wires	2 ounces

TUNING:

Access to controls	Excellent
Ease of adjustment	Very good

PRICE:

Sug. retail	\$119
Warranty	90 days

ELECTRICAL:

(Manufacturer's Specs)

Maximum no. of cells	10
----------------------------	----

Minimum no.

of cells	4
Max current	Unlisted
Continuous current	250 amps
Resistance	0.003 ohm

TEST PARAMETERS:

Voltage	6 volts
Current	12 amps
Voltage drop along full length of wires	0.27 volt
Voltage drop at 2-inch point	0.07 volt
Resistance to end of wires*	0.0225 ohm
Resistance at 2-inch point*	0.0058 ohm
BEC Output, 6-cell battery	5.69 volts

*Resistance = Voltage Drop / Current

COMMENTS: at last, here's a sport-model ESC with the innards of a pro model. The 410-M5 has the current-handling capacity to cope with 7-cell packs and modified motors. It's small and light and should fit in any 1/10- or 1/12-scale vehicle. If you're really into racing and need a controller that can run with the best but you don't have the dough to buy a pro racing model, check out the 410-M5. If you aren't into racing but are looking for a reasonably priced sport-model ESC to replace that pesky, burned-out, mechanical speed controller, the 410-M5 is the perfect choice. Even backyard throttle-jammers need a bulletproof ESC that runs coolly and is a hot performer.

I crossed my fingers and connected the battery pack backward. Sure enough, all that happened was that the fuse popped its solder joint! I reinstalled the battery properly, re-soldered the fuse and the 410-M5 was back to normal, working just as a purebred racing ESC should.

TIME FOR A FUN RUN

During the time I needed to road-test the 410-M5, I was invited to my oldest son's home in Tennessee for a family picnic, and knowing that there would be two young boys there (my grandsons!), I figured I'd better take a running R/C car to the party. I knew that the grass would be rough in Mark's yard, so I took my Kyosho Sideways, which has bigger wheels than my other cars.

The installation of the 410-M5 in the Sideways went smoothly. With the manual's detailed instructions and the factory-installed connectors, even beginners should be able to handle it.

Before heading to Tennessee, I drove the car on the dead-end street in front of my house to make sure it was in good running condition. I'm always amazed at how smoothly these new-generation high-frequency ESCs work—especially at the mid to low throttle settings. This controller is an absolute dream. It's smooth, fast and runs coolly. Run times were very good, and the brakes are strong. Comfortable that the car was working well, I headed to Tennessee to let the rug rats have a whack at driving it.

Well, grass is never a good surface on which to run a buggy, and tall grass is the pits. Against my better judgment, I let the boys run the Sideways, and after fighting the grass every inch of the way, the motor was so hot that it smoked! A quick check of the 410-M5's heat sink verified that this controller has world-class low resistance; it was barely warm.

I allowed the motor to cool and then installed the smallest pinion that I had in

my toolbox. By the end of the day, the boys had pretty much trashed the car's motor, but the 410-M5 never worked up a sweat. For a sport-model controller, the 410-M5 is impressive.

As I said earlier, the 410-M5 and the 410-M1c have identical "on" resistance ratings and current ratings. All my tests verified that the 410-M5 has the price tag of a sport model and the heart of a pro model. As with all the sport models that I've tested, the Tamiya-style connectors rob the motor of much more power than the controller does.

This controller has all the features that any buggy driver could ever want, e.g., high-frequency motor control (extremely desirable), low "on" resistance (the most important specification) and low price (the frosting on the cake). The only problem arises because of the battery and motor connectors and the slightly smaller battery and motor wires (the 410-M1c has thicker wires). You can solve this problem by replacing the connectors with a high-performance-style connector, e.g., Sermos* Power Pole connectors. (Don't worry; this won't void the warranty.)

The 410-M5 has the current-handling capacity to cope with 7-cell packs and modified motors. It's small and light, and it should fit in any 1/10- or 1/12-scale vehicle. If you're really into racing and need a controller that can run with the best but you lack the funds to buy a pro racing model, check out the 410-M5. I think that the few features that are missing from it are ones you can live without.

If you're tired of blaming your losses on your lack of a good ESC, direct-wire a 410-M5 into your car, and you'll have to find a new excuse for losing. Of course, if you aren't into racing but are looking for a reasonably priced sport-model ESC to replace your buggy's pesky, burnt-out, mechanical speed controller, the 410-M5 is the perfect choice. Even backyard throttle-jammers need a bulletproof hot performer that runs coolly.

**Here are the addresses of the companies mentioned in this article:*

Novak Electronics Inc., 128-C E. Dyer Rd., Santa Ana, CA 92707.

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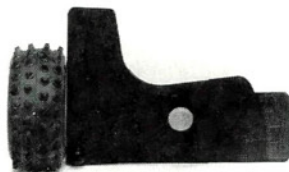
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SIZZLER

(Continued from page 32)

throttle! After its brief, violent, encounter with the wall, I couldn't steer the Sizzler, and its body was flapping in the breeze.

When I pulled the car off the track, I noticed that its entire front end had rotated (massive caster adjustment!) and shifted sideways by about an inch. Further, the cross-brace that runs to the right front had snapped.

Back in the shop, I tried to find the answer to the question, "Why?" Not "Why had I been so stupid to drive the way I did?"; but "Why had the front end suffered such a major breakdown?" I soon discovered why. The stock, front, aluminum brace is supposed to hold the front end in place and prevent it from shifting. With a little pressure on this brace, I discovered that I could push it around in the block. As a locking device, it had failed miserably. I drilled and tapped a hole in the top of the block and installed a setscrew. This prevented side-to-side movement, and it also prevented the axle from rotating within the blocks.

The front brace snapped because the body post was mounted to it and, when the body was pushed back against the post, something had to give. In this case, it was the brace. To solve this, I mounted the body post on the front bumper (yes, the car has one).

READY TO RACE

Feeling confident that I had solved all the car's problems, I decided that it was time for a modified motor. In went my 12-turn, single-wind B&R motor and Max Cell* conditioned SCR batteries and off I went to the track. The results? During the first race, I made better lap times and ran more laps than I had ever run at that track! The

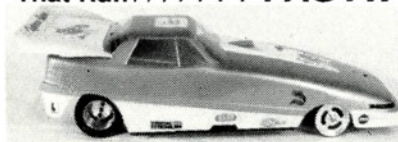
(Continued on page 54)

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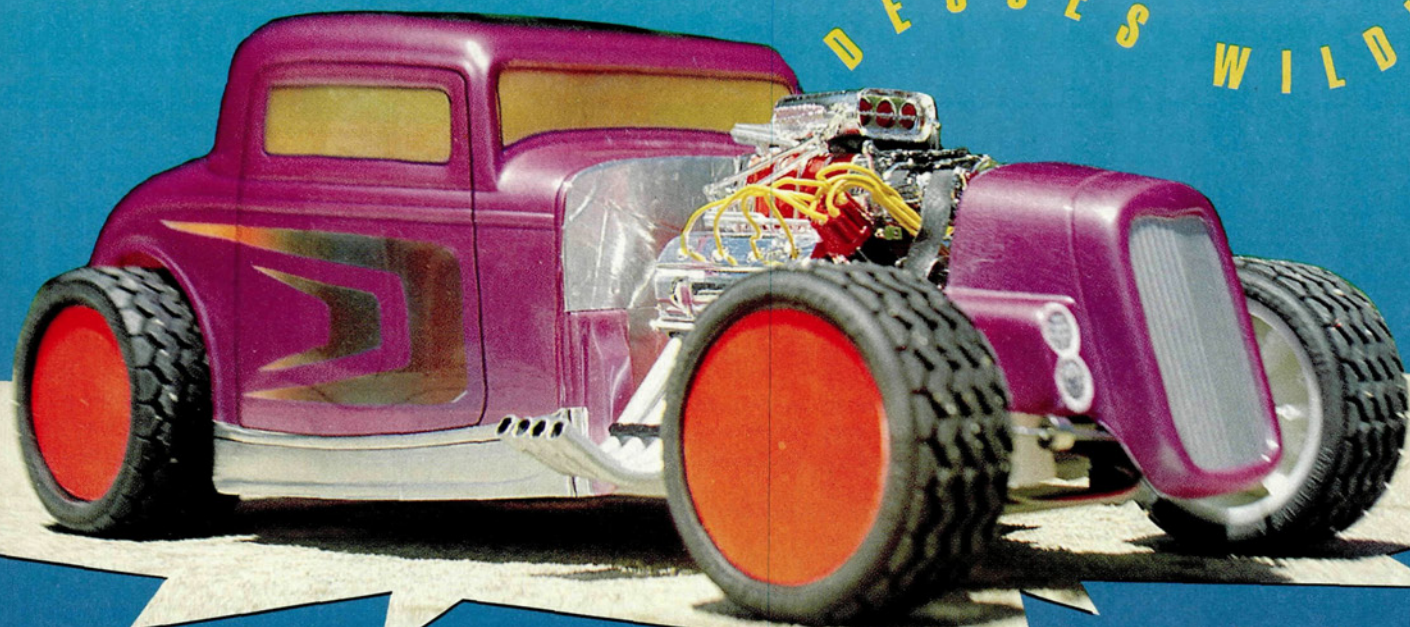
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DEUCES WILD!



IT'S ABSOLUTELY AMAZING to me just how sophisticated, technical and diverse the field of R/C cars has become. When the craze started some years ago, it was, as most new things are, greeted by the cheers and hurrahs of its supporters. Along with the applause came the cynicism: "It'll blow away just like hula hoops, Nehru jackets and electric slot cars." Surprise, doubting Thomases! Place your words between two slices of your favorite trendy bread and enjoy. Not only has the R/C car market survived, but it has also grown and prospered, and it now represents a major segment of the R/C industry.

PARMA HEMI COUPE

b y R I C H U R A V I T C H

PHOTOS BY RICH URAVITCH

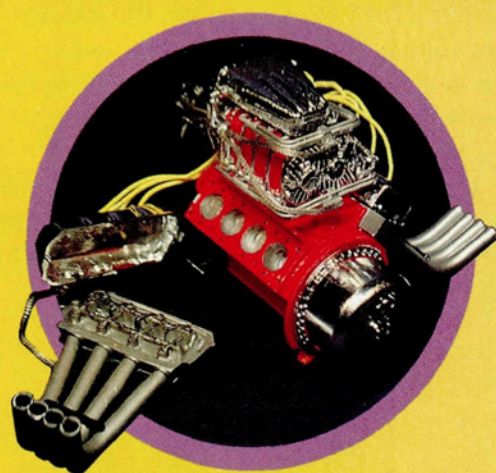
Those of you who are interested in full-scale cars, even if it's only to read about them, have already heard of "The Hemi Head." Its

yesteryear's hemispherical combustion-chamber monster snarled, bellowed and roared.

Have we really progressed along the

than that to drive the same distance in your Honda Civic, Hyundai or similar econo-box, any of which you'll have to make an appointment with to get to 60mph.

The Hemi is back, although at a much reduced size, in the form of a 1/10-scale model available from Parma. It's included with the Hemi coupe kit reviewed here, but Parma has thoughtfully made it available separately, and it will surely find its way into other scale street machines. The detail is superb and the heads press-fit onto the block but can be removed to display the valve train,



pistons and other combustion-area finery. The optional detailing kit will allow you to add ignition harnesses and fuel lines. The kit even supplies a stand—perfect for putting the

engine on display outside the car. The engine itself has been around for quite some time, although not in this form. It's good to see it back; I just wish the real one could take the same course!

It's All In Your Head

very name conjures up the image of maximum performance: snarling, fire-breathing, huge-displacement engines equipped with cams that would jar the fillings out of your teeth and are incapable of idling much below 2,000rpm! Though today's "high-performance" engines buzz, whistle and whine,

performance path with turbos, "intercoolers" and other pseudo-tech devices? Think about it: a '60s 400ci-plus hemi could provide phenomenal acceleration in any vehicle of the era. Sure, it would only get 10 to 12mpg, but a buck's worth of gas would get you 40 to 48 miles. Today, it costs more

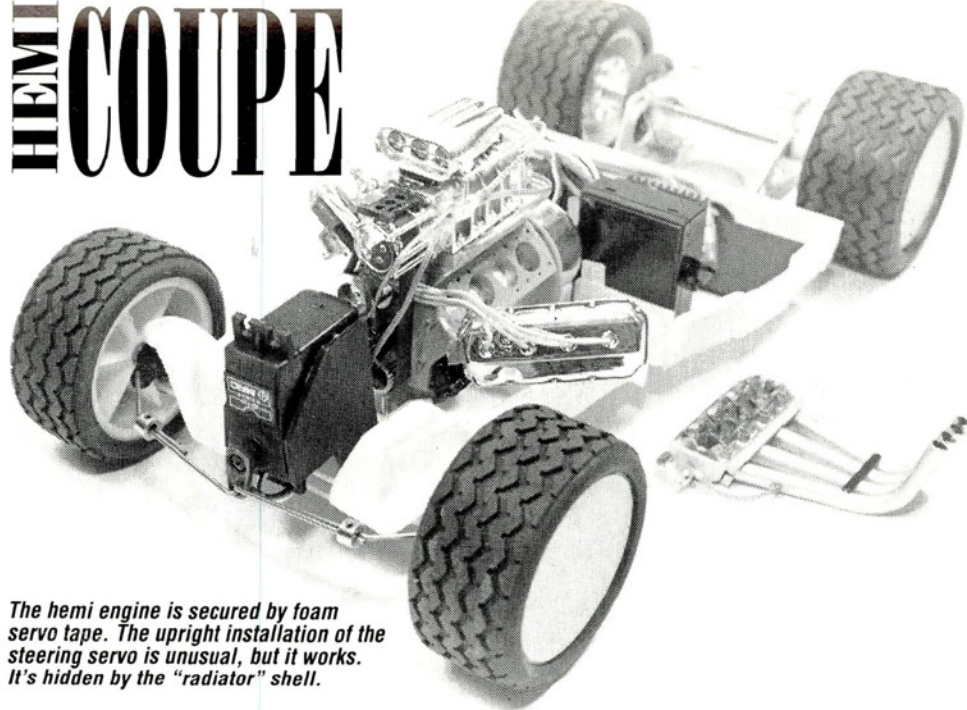
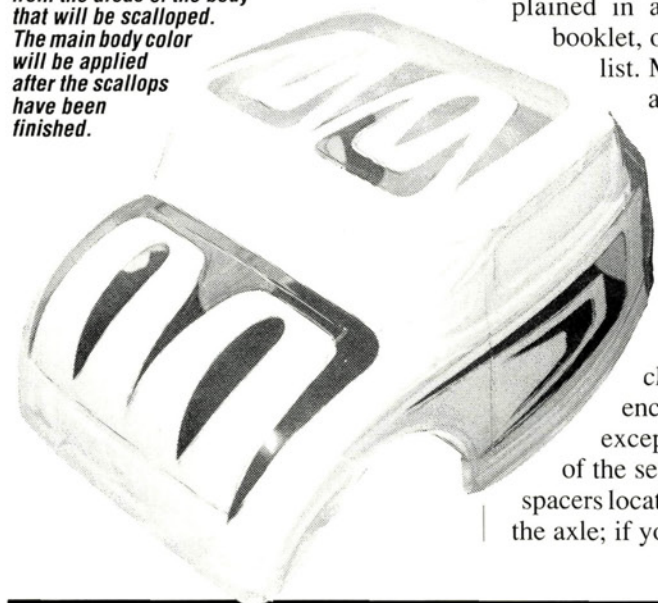
HEMI COUPE

This growth is a consequence of manufacturers providing us modelers with the variety of products that now exists. When I first got into the hobby, it was in its infancy, and virtually *all* the activity involved off-road racing. I enjoyed it, but I was more interested in scale projects. I satisfied the urge by painting and detailing the injection-molded bodies of the early off-roaders to resemble full-size Baja-type competitors. Some pioneering manufacturers recognized the need for something more durable than injection-molded polystyrene, and vacu-formed clear bodies began to appear.

Parma* was there at the beginning. Given their extensive experience in the slot-car body business, it was only natural for them to expand their involvement to include R/C car bodies. Their line now consists of dozens of bodies ranging from monster trucks to stockers, and it includes some scale machines. Their newest release, and the subject of this "Track Report": (*street* report, actually!) combines some great ingredients and represents a major breakthrough to scale R/C car enthusiasts.

Built from the cars of the '20s and '30s, street rods have always been among my favorite iron. Chopped and channeled three-window coupes have a place in the heart of nearly any backyard hot-rodder who got grease under his nails growing up in the '50s and '60s. I fit the bill, so when Parma announced the release of its Hemi coupe, I was eager to give one a try. Here's what I found.

The tape has been removed from the areas of the body that will be scalloped. The main body color will be applied after the scallops have been finished.



The hemi engine is secured by foam servo tape. The upright installation of the steering servo is unusual, but it works. It's hidden by the "radiator" shell.

WHOLELY ROLLER

The kit should be considered a "basic" one; it requires other components that must be purchased separately. To complete the rolling chassis, you'll need to come up with some type of speed controller and a motor with a pinion gear—in addition to the usual 2-channel radio and battery pack. The kit includes the 1/10-scale Hemi engine, but as long as you have your credit card out, add the detailing kit for the engine also. It includes braided lines, an ignition harness and other goodies that make the well-detailed Hemi come alive.

The chassis assembly is explained in a six-page instruction booklet, one page of which is a parts list. Most parts are poly-bagged, and each bag (A, B and C) is identified by letter. The assembly is arranged so that the bags are used in sequence; completion of each step results in a completed sub-assembly.

Step "A" describes the rear-end buildup, which includes the ball-diff. You won't encounter any problems here, except the drawing shows three of the seven supplied 1/8-inch nylon spacers located on the gear (right) side of the axle; if you assemble it that way, the

rear end will be offset and out of line with the front track. Use *one* spacer between the spur gear and the motor mount (which the instructions call the "rear pod"), and use the rest on the left side. This will match the rear track with the front.

Incidentally, although the instructions identify the motor mount as part no. 26, it doesn't appear in the parts list, nor does part no. 30, the fiberglass chassis plate.

Successfully completing step "B" will reward you with a finished front end and bring you to the body trimming and painting phase. Three polycarbonate

parts are included in the kit: the body, the grill and the frame. Take them all through the preparation ritual: trim them carefully, sand their edges and wash them in a soapy solution before you mask and paint them.

Parma's instructions in this area are thorough and accurate but, naturally, they don't go into detail on how to do "trick" paintwork; that kind of info can be found in the frequent articles on the subject in *Car Action*. I used Pactra* Racing Finish paints on my coupe and found that it sticks well to polycarbonate. The Pearl Purple looks outstanding but it took many thin coats to achieve the desired effect. I masked and airbrushed the scalloped accents in graduated hues from bronze to

The 1/10-scale Mopar hemi-head engine included with the coupe kit has to be the *pièce de résistance*, the *objet d'art*, the rad, killer component.

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SIZZLER

(Continued from page 46)

Sizzler went on to the A-Main, where, owing to some poor mechanical work on someone's part (I seated one of the brushes incorrectly), it "DNF'd." By the way, with the 148 servo and full, race-ready gear, the Sizzler weighed 2.68 pounds.

The Sizzler lives up to its name; it sizzles! It's difficult to assemble, but you can adjust it to handle as well as most cars. It's also very durable. It has had several collisions since its initial one with the wall, and it hasn't been damaged. Finding Sizzler parts at your local hobby shop is a problem, but PB carries a full line of them, and you can use several over-the-counter replacement parts in this car. In England, PB is currently working on an LTO car. The company plans to fix some of the problems that I discovered (i.e., the left-side motor-plate clearance) on this version as well as all other cars, too.

If you want to just stand around and copy the others at the track, forget the Sizzler; stay away from it. If, however, you want to be more than just a follower—someone who drives a fast car with superior handling that's just a little different—get a Sizzler!

**Here are the addresses of the companies mentioned in this article:*

PB Sales and Racing, P.O. Box 51589, New Berlin, WI 53151.

Bolink R/C Cars Inc., 420 Hosea Rd., Lawrenceville, GA 30245.

Du-Mor R/C Inc., 1002 Union Landing Rd., Cinnaminson, NJ 08077.

B&R Motorworks, 28000 Tothill Dr., Saugus, CA 91350.

Futaba Corp. of America, 4 Studebaker, Irvine, CA 92718.

Novak Electronics Inc., 128-C E. Dyer Rd., Santa Ana, CA 92707.

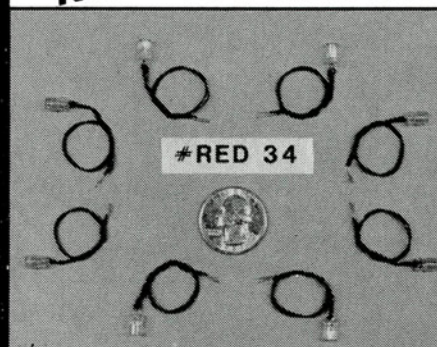
Tekin Electronics Inc., 970 Calle Negocio, San Clemente, CA 92672.

MRP Inc., USA, 18676 142nd Ave. NE, Woodinville, WA 98072.

(Continued on page 66)

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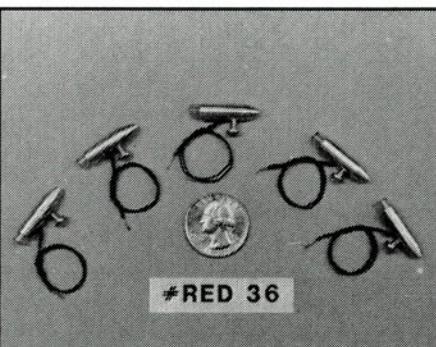
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BATTERY BLOWOUT!

WAY BACK WHEN I FIRST STARTED electric-powered R/C car racing, I went to the track with one battery pack, or two if I wanted a fresh one for the main event. I often charged and recharged the packs without worrying about how well they'd perform the next time around. Motors weren't that powerful then, and that made making the run time relatively easy. The motors were geared for the best performance given the track conditions, not for run time.

Modern R/C car racing offers consumers many more power options, including batteries with increased capacity (1400 and 1700mAh instead of 1200mAh); high-frequency speed controllers (which are more efficient); and super-hot motor winds (to provide as much power as you can hold on to). This sounds great, but these power-hungry motors have shifted the emphasis from proper car set-up and gearing to how well the batteries perform. With the many motor options available in modified racing, there's never a problem finding horsepower; the problem is finding a battery that will take you the distance.

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the most
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for
your
buck?

Glance at
our test
results...

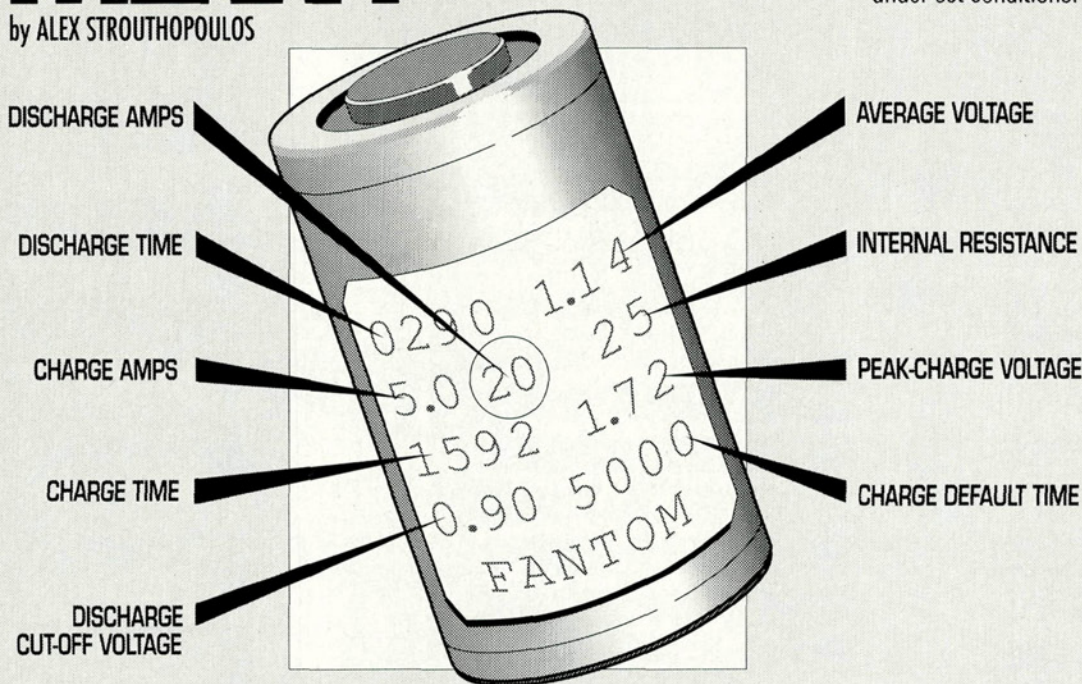
by STEVE POND

BATTERY BLOWOUT!

What does it all MEAN?

by ALEX STROUTHOPOULOS

The Competition Electronics Turbomatcher is a state-of-the-art battery matcher. Using this high-dollar equipment, battery matchers have a variety of ways to test and match individual cells. All Turbomatchers print out two types of numbers on the cell labels: the set values at which the cells are matched; and the performance of the cells under set conditions.



These are the numbers listed on most cells, but what do they mean?

- **CELL DISCHARGE TIME** is the elapsed time (in seconds) it takes for the cell to discharge at a set amp rate. If all the cells in a battery pack are matched to within a few seconds of one another, the pack will discharge evenly.
- **DISCHARGE VOLTAGE** shows the voltage that a cell puts out during the discharge cycle. The higher the number, the more voltage the cell is putting out (which, in turn, makes your car go faster).
- **CHARGE AMPERAGE.** To obtain consistent readings, all tested cells must be charged at a similar amp rate. The industry standard for charging seems to be around 5 amps.
- **DISCHARGE AMPERAGE.** The higher the amp load during discharge, the greater the stress put on the cell. This effectively "weeds-out" the weaker cells. A discharge rate of 20 amps is standard.
- **INTERNAL RESISTANCE** is often called the "punch number." The lower the resistance, the faster the voltage reaches the motor. An average reading for SCRs is between 25 and 40; for SCEs, the range goes from 40 to 70.
- **CHARGE TIME** is rated in seconds. Average values for charge times vary, but as a rule, SCRs range from 1,400 to 1,600 seconds and SCEs range from 1,900 to 2,200 seconds.
- **PEAK VOLTAGE** is the voltage reading when the cell reaches peak charge.
- **DISCHARGE CUTOFF VOLTAGE** should be .90 volt. Typically, a cell isn't useable when the voltage drops below 1 volt, so .90 is generous enough. Lowering this number to below .90 volt boosts the discharge time to a false level and makes the cell look better than it really is.
- **CHARGE DEFAULT TIME** shows the time at which the matcher stops reading the voltage from the cell. For example, if the charge default time is set at 20, at 20 seconds into the discharge, the Turbomatcher will stop reading the voltage but it will continue to read the discharge time.

The Turbomatcher takes precise readings of several aspects of every cell. The use you make of these figures is up to you but, remember, no two cells will perform in exactly the same way. Personally, I go by the old saying: "Ignorance is bliss"!

BETTER BATTERIES

The ever-increasing emphasis on extracting the best performance from batteries has prompted many racers at highly competitive levels to increase their stock of batteries. A fresh pack for every run and a couple for practice is now the rule. Matched packs have also become very popular because they supposedly provide a better performance than a pack that's composed of randomly picked sub-C cells.

Early matched packs were simply available as "matched," but there was no indication of how good they were. With the help of sophisticated electronic matching equipment, today's matched packs are matched for run time at a given amperage, voltage, internal resistance and a couple of other factors that are supposed to ensure that consumers know exactly how well the battery will perform in a car.

Early in the matched-pack boom, legitimate cell-testing equipment was very expensive because it was new technology. Anyone who wanted to sell matched packs in quantity had to invest a substantial chunk of money. Recent developments in matching equipment, however, have made getting into the battery business a less expensive proposition.

Battery test results

Company	Cell's average discharge time in seconds (4 cycles)						Maximum variation of pack (in seconds)	Maximum variation of a given cell (in seconds)	List price	Run time per dollar (in seconds)
	Average voltage									
MaxCell	1400mAh packs not available at press time									
	<u>331</u> 1.09	<u>339</u> 1.10	<u>330</u> 1.10	<u>331</u> 1.10	<u>335</u> 1.09	<u>336</u> 1.10	9	18	\$65	4.31
Parma	<u>288</u> 1.13	<u>283</u> 1.13	<u>284</u> 1.13	<u>285</u> 1.12	<u>286</u> 1.13	<u>2.84</u> 1.13	5	14	\$33	8.64
	<u>330</u> 1.09	<u>341</u> 1.08	<u>331</u> 1.09	<u>328</u> 1.08	<u>343</u> 1.09	<u>332</u> 1.09	15	12	\$48	6.98
Power Pak	1400mAh packs not available at press time									
	<u>333</u> 1.09	<u>352</u> 1.10	<u>348</u> 1.10	<u>342</u> 1.10	<u>344</u> 1.09	<u>354</u> 1.10	21	15	\$68	4.91
PTI	<u>283</u> 1.13	<u>286</u> 1.13	<u>289</u> 1.13	<u>286</u> 1.12	<u>289</u> 1.13	<u>290</u> 1.13	7	7	\$75	3.82
	<u>341</u> 1.10	<u>352</u> 1.10	<u>349</u> 1.10	<u>344</u> 1.11	<u>341</u> 1.09	<u>347</u> 1.10	11	18	\$84	4.12
Reedy	<u>292</u> 1.13	<u>292</u> 1.13	<u>292</u> 1.13	<u>294</u> 1.13	<u>293</u> 1.14	<u>292</u> 1.13	2	13	\$70	4.18
	<u>341</u> 1.10	<u>345</u> 1.09	<u>340</u> 1.10	<u>339</u> 1.10	<u>345</u> 1.09	<u>345</u> 1.09	6	7	\$77	4.45
Team Losi	1400mAh packs not available at press time									
	<u>324</u> 1.09	<u>329</u> 1.10	<u>331</u> 1.09	<u>328</u> 1.09	<u>332</u> 1.09	<u>332</u> 1.10	8	10	\$78	4.22
Team Orion	<u>276</u> 1.13	<u>284</u> 1.13	<u>281</u> 1.13	<u>277</u> 1.12	<u>287</u> 1.13	<u>279</u> 1.13	8	11	\$65	4.31
1700mAh packs not available at press time										
Team Smooth	<u>293</u> 1.13	<u>294</u> 1.14	<u>296</u> 1.13	<u>292</u> 1.13	<u>287</u> 1.14	<u>295</u> 1.14	9	10	\$70	4.18
	<u>332</u> 1.10	<u>329</u> 1.09	<u>333</u> 1.09	<u>340</u> 1.10	<u>327</u> 1.10	<u>332</u> 1.10	13	21	\$102	3.25
Trinity	<u>296</u> 1.13	<u>302</u> 1.13	<u>299</u> 1.14	<u>299</u> 1.13	<u>301</u> 1.13	<u>304</u> 1.13	8	9	\$65.99	4.55
	<u>338</u> 1.08	<u>342</u> 1.09	<u>334</u> 1.09	<u>332</u> 1.10	<u>343</u> 1.09	<u>337</u> 1.09	11	12	\$70	4.83
1400mAh										
1700mAh										

Today's matching equipment is not only cheaper, but it's also capable of churning out many more packs. The result has

been an ever-increasing number of companies offering matched packs. There's a down side to all this: designed with

racers in mind, the battery-testing equipment is very flexible; testing parameters can be altered to suit specific applications.

Some matching services, however, have taken advantage of this flexibility to produce higher discharge numbers than the

cells are actually capable of. Though the unscrupulous battery companies are the exception and not the rule, there's no way to tell what you're getting for your money until the pack has been assembled and run in your car or truck. Once the pack has been used, it can't be returned, even if you feel you've been cheated. It's used!

R/C Car Action's battery-test lab consists of a Stormer MA70T power supply, a Competition Electronics Turbomatcher and a Spectrum LX-80 printer. To ensure accurate, comparable results, we used the same machine for all the tests.

BATTERY BLOWOUT BASICS

The most popular device used for cell matching is the Turbomatcher from Competition Electronics*, and the staff of *Car Action* decided to put together this "Battery

Blowout" to let you all know exactly what you're getting for your money.

The criteria we used to compare the packs in the test are simple:

- the packs must be available nationally

through distributors and hobby shops; • the packs must be sold as "matched."

To avoid having battery companies supply us with "killer" packs for the test, we went to one of the area's largest

BATTERY BLOWOUT!

Matching and selling batteries has become a big business. Consumers want to know what they're buying, and they're willing to pay a healthy price for what they consider to be a premium pack. But how do you determine what's a premium pack?

Most of us would assume that, by looking at the labels on the matched cells, we can tell which is the best pack for our money. Owing to the absence of consistent testing parameters for battery matchers however, it seems to be virtually impossible to compare the performance data of brand-name packs.

While testing batteries for this article, I came across some battery packs from one of the smaller battery matchers—Atomic Racing—in a hobby shop at a

local racetrack. Just like any of the other cells available from other battery companies, they were Sanyo 1400mAh SCRs bearing printed labels to show how the cells performed in a battery-matching device. On one of the packs, there were labels showing the high 300s (307 to 308) with an average voltage of 1.16 and 1.17!

After touring a number of large, battery-matching facilities, I know that you'd be lucky to get *one* cell this good!—never mind enough to make a whole battery pack. I had a sneaking suspicion that something wasn't right, so I decided to fork out the 66 bucks they were asking for this pack, bring it to our testing facility and put it through the same tests as the rest of the batteries.

The labels on the Atomic Racing cells gave only five "facts": discharge time; average voltage; charge amperage; discharge amperage; and the cells' internal resistance. To unsuspecting consumers, this might seem to be enough information to be sure that these were killer cells, but common sense told me better. Noticeably absent from the cells was info on two factors that determine how these great numbers were generated: the voltage cut-off point and the default setting for average voltage readings.

Though there's no established

standard for when the discharge cycle should end for matching batteries, the limit assumed by most manufacturers is .90 volt per cell. By lowering the voltage cut-off point to, say, .30 volt for each cell, the discharge time shown on the cells can increase by 5 to 10 seconds. But if the information isn't given, you don't know where the cycle ends.

The default setting that cuts off when the Turbomatcher stops reading a cell's voltage to come up with an average can also be altered to affect the results. For instance, with the default setting at 5,000 seconds, it's guaranteed that the average voltage printed on the cell's label is accurate. When this setting is changed to, say, 100 seconds, the machine will only read the voltage of the cell for the first 100 seconds of the cycle, and this will result in a very high—and misleading—"average" voltage. Again, if the information about where the default was set isn't on the label, you can't judge how good the cells actually are.

THE WHOLE TRUTH...

I put these cells on our machine and set it for a 5A charge and a 20A discharge, and I left the voltage cut-off at .90 volt and the default at 5,000 seconds. I cycled the cells four times, and my suspicions were confirmed. The average discharge

The Hall of Shame

hobby shops and bought every pack we could get over the counter. From each matched-pack manufacturer, we ordered a 1700 SCE and a 1400 SCR pack.

The test parameters were:

- charge and re-peak on the Turbomatcher at 5 amps;
- discharge on the Turbomatcher at 20 amps;
- voltage cut-off at .90 volt;
- default setting at 5,000 seconds.

For some battery matchers, this is the standard to go by, but some matchers alter the charge, the discharge, the voltage

cut-off and the default setting. Some think their own settings (whatever they might be) are more suitable for R/C racing; others alter the settings to deceive consumers. When all the relevant information isn't printed on the cells in a pack, we assume that the aforementioned parameters were used; but they might have been changed to make it look as though the cells are better, when, in fact, they might not be. Such deception is the exception rather than the rule; but in many cases, there's no way to know until you try the packs and, by then, you own them.

For our tests, we used what's called the "Version 6.1" in the Turbomatcher. This new chip is available through Competition Electronics; it prints *all* the information gathered by the unit on the cells' labels. With this, consumers will know whether or not the standard settings were used.

The results printed in the chart show: the

times for all the cells over four cycles was exactly 300 seconds, not the 306 or 307 seconds marked on the labels. Further, the average voltage was 1.13 (very standard for 1400 SCRs), not 1.16 volts.

Fortunately, Atomic Racing is one of the more upstanding matchers; although the cells weren't what they *appeared* to be, they were surprisingly good. As matched packs go, one that consistently rated 300 seconds can be considered "premium grade." This doesn't, however, absolve the company from its responsibility for what I feel is a deceptive practice. No, they can't be held responsible for these numbers because there are no specified testing parameters for Ni-Cd batteries for R/C racing; but, across the board, the parameters that govern the cut-off point and default settings are very consistent among battery matchers: .90V cut-off; 5,000-second default. If these parameters are changed for any reason, I think consumers should be told.

To protect yourself from misleading claims, I suggest that you buy only packs that have *all* the numbers printed on the cells. This unfortunately puts the burden and cost of updating the equipment on upstanding battery companies, but until all the information is available to us, we'll be in the dark about how good batteries really are.

The appeal of matched batteries is obvious: the better the pack, the faster and longer you can expect to run your car. Many consumers are willing to pay extra for a "good" matched pack, but is the price you pay really justified?

During our test, we noticed a tremendous difference in each cell's performance with each cycle. With the SCRs there was 10+ seconds difference in run times with a given cell over the four cycles. The more delicate SCE showed a difference in discharge times of 20+ seconds!

Consumers are paying premium prices for cells that are labeled as having very good numbers. One company offers a \$55 SCR pack that's rated at more than 300 seconds (301 to 310). The next down from these packs are those claiming 290+ seconds (290 to 299) for \$42. Theoretically, you're paying \$13 more for a pack that offers only between 1 and 10 seconds more run time, but the cells fluctuate as much as 10 seconds with exactly the same testing parameters on the same equipment! You might be paying \$13 more than you need to, because that 301 pack could very well be a 290. Alternatively, a pack may improve, but you'll never know, because the cells change with every cycle.

I'm not chastising a particular company; everyone is at the mercy of the cells' manufacturing tolerances and the accuracy of test equipment. But is it fair to charge such a premium price for cells that could "fall out" of their price category with a single cycle?

By the same token, consumers shouldn't be too impressed with

average results for each cell in the pack through four cycles; maximum variation (in seconds) of all the cells in the pack; maximum variation (in seconds) of a given cell; and the suggested retail price of the battery pack. Discharge time was

divided by the retail price of the pack to tell you how much run time you're getting for your hard-earned bucks.

**Here's the address of the company mentioned in this article:*
Competition Electronics,
P.O. Box 10183, Scottsdale,
AZ 85271. ■

Playing the Numbers Game

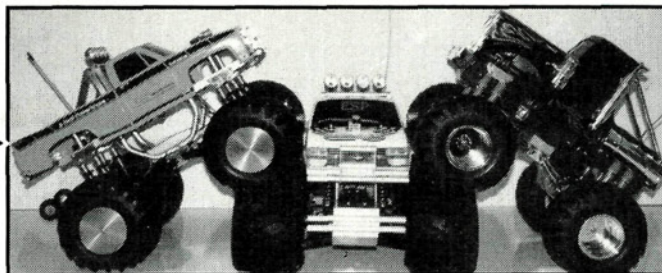
the high discharge numbers on certain cells. There are always a couple of people at any hobby shop who'll say, "I won't buy an SCR pack that's rated below 300 seconds!" The only rational response to this is that they're doing themselves a disservice by turning up their noses at a 295 pack that may really run better than the 302 pack they spent much more money on.

Likewise, until you can take the perfect line through every turn and accelerate smoothly enough to make the best use of the batteries, you're wasting your money on the killer packs, because the extra 5 seconds of run time you're paying for could be used up by going too wide in one turn!

The bottom line: there shouldn't be such wide variations among the prices of matched packs. The cells aren't good enough to guarantee that you'll get that extra 5 seconds of run time you paid \$13 for. Also, we should all be more realistic when buying batteries; the fact that they're matched as accurately as possible is worth more than the extra 5 seconds of run time!

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SIZZLER

(Continued from page 54)

Max Cell, P.O. Box 1211, Mount Laurel, NJ 08054.
Bud's Racing Products, 1575 Lowell St., Elyria, OH 44035.
Lightning R/C, 17123 Seven Pines, Spring, TX 77379.
TRC, P.O. Box 1058, Albemarle, NC 28001. ■

HOME-BUILT PROJECT

(Continued from page 37)

Airtronics radio for guidance. Power is provided by a Novak T-4 ESC, and an MIP* tranny puts the power to the ground. Taking no chances, Carlo custom-made a hitch to make sure that the trailer and car would never be left behind.

BUT WAIT...THERE'S MORE

If you think we've covered *all* of Carlo's

accomplishments, you're wrong! He doesn't just paint incredible car bodies; with another concours-winning creation, he's also the current IEDA World Champ in 1/10-scale Top Alcohol Class. On top of all this, Carlo has a full garage that contains just about every type of racing car currently made—including gas dragsters and fuel-burning off-landers. Each car has a body that most drivers would worry about scratching—all concours class.

Carlo has been involved with R/C racing for about seven years. A neighbor introduced him to R/C, and he soon had his first vehicle—a Tamiya Blackfoot truck. This got him hooked for good, but he also decided that running a *good-looking* car is just as important as winning. His true loves are scratch-building and detailing cars, and his ultimate goal was to see his cars on the pages of a magazine

and, in this way, leave his mark on the world. Obviously, his time has come! *R/C Car Action* salutes Carlo Bruno and his fine work. Keep it up! We're sure there's lots more to come!

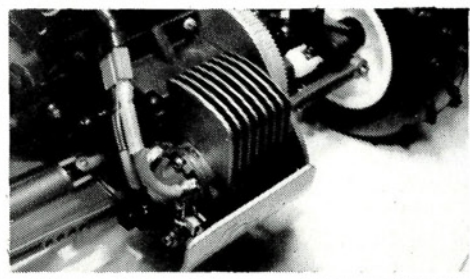
**Here are the addresses of the companies mentioned in this article:*

Andy's R/C Products, 1710 Grevelia Ct., Ontario, CA 91761.
Associated Electrics Inc., 3585 Cadillac Ave., Costa Mesa, CA 92626.
TMS Enterprises, 148-A Del Amo Blvd., Torrance, CA 90501.
Twister Motors, 657 E. Arrow Hwy., Suite H, Glendora, CA 91740.
Tekin Electronics, 970 Calle Negocio, San Clemente, CA 92672.
Novak Electronics Inc., 128-C E. Dyer Rd., Santa Ana, CA 92707.
Airtronics Inc., 11 Autry, Irvine, CA 92718.
Parma International Inc., 13927 Progress Pky., North Royalton, OH 44133.
MIP, 746 E. Edna Place, Covina, CA 91723. ■

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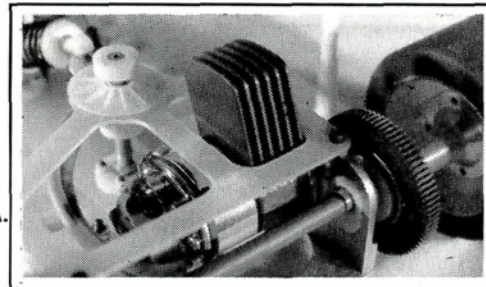


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RIDING THE

R/C RACING'S TOP

by STEVE POND

TECHNOLOGY has advanced a lot since the first cars rolled off Detroit's assembly lines, and now such cars exist in the shadow of today's high-performance machines. Although the R/C hobby is much less mature, its technology has also advanced, and the cars we race now are much faster than their predecessors.

Until a few years ago, when Futaba* introduced its PCM radio, most of the advancements involved cars,



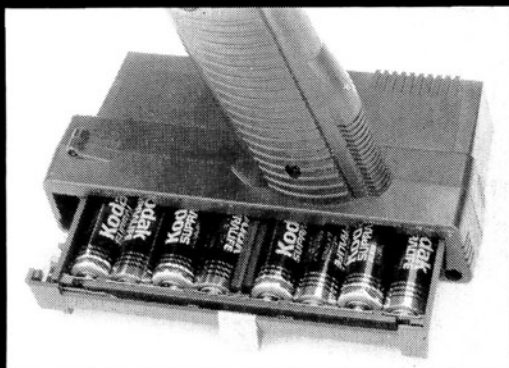
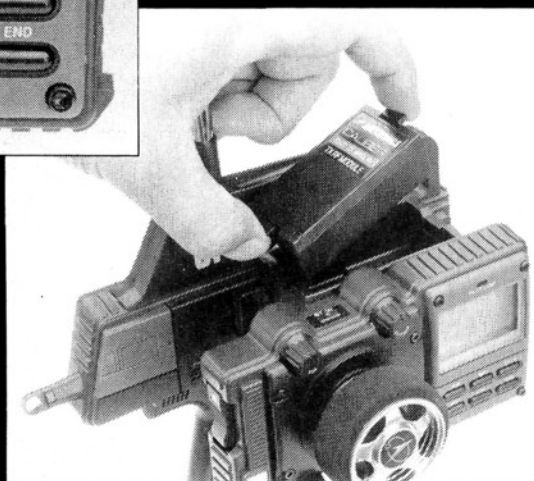
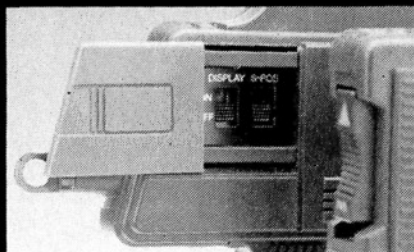
AIRWAVES

D TRANSMITTERS

motors and batteries—not R/C guidance systems. Today's R/C competition cars perform so well that we need lightning-quick reflexes, yet, to maintain control, we also need a "soft touch." This can be slightly intimidating, but recent advancements in radio technology have provided us with forms of "artificial intelligence" that help us guide our cars. The features on these 20th-century transmitters allow us to pilot our fast machines with ever-increasing ease.



AIRTRONICS CALIBER 3P



Top left: most of the Caliber's trim functions are controlled at its LCD display. ■ Above: the module is conveniently located on the bridge between the radio's handle and face. ■ Below: the Caliber comes with the 92237 receiver and a pair of 94102 servos. ■ Left: instead of the conventional "ammo-clip" battery-loading setup, put the cells side by side on the bottom of the Caliber's radio box. ■ Above left: to prolong battery life, you can turn off the LCD display at this panel. The S-POS switch makes it easier to start and warm up the engines in gas-powered cars.



Airtronics'* new Caliber 3P radio has such a slew of features, that it has only recently been superseded by a system that's substantially more expensive. Its ergonomic design enables you to adapt it for left- or right-hand operation. Although many left-handed drivers have adapted to right-hand radios, those who can't get the swing of it think this feature is priceless. The 3P's grip can also be adapted to fit most hand sizes—another plus.

This radio has an on-board computer that's the first of its kind, and it offers many features that have never before been available on racing surface systems. To adjust them, you use numerous control knobs and the LCD control panel on the 3P's face. Although I could write a treatise on each function, I'll just list what's available. The steering functions include: adjustable-rate control (ARC); adjustable-rate control point (enables you to set exactly the point in the servo's travel and/or the speed controller's throttle response curve at which the ARC will take effect); dual rate; end-point adjustment; data and trim memory; and servo-reversing. The 3P's throttle

TOP TRANSMITTERS

functions include all of those listed under steering as well as a starting-position function. This makes it easier to start and warm up engines in gas-powered cars or boats, and it prevents the stalling that's common with cold, idling engines.

You control the 3P's features with "function-select" keys that include: a key lock to save critical data in the computer's memory; a command signal to turn the beeping indicator on or off; an onboard stopwatch with two modes (a countdown timer and a standard timer that counts upward from

zero); a digital battery-voltage display; a "model select" to store trim settings for up to three models; and data copy and reset functions to copy or delete stored data.

The 3P also has interchangeable RF modules that enable you to switch frequency channels (i.e., from 27 to 75 or vice versa) and four easy-to-access adjustment dials located near the steering wheel for the auxiliary third channel, the steering trim, the throttle trim and the throttle end-point adjustment (braking). Another dial on the radio's grip lets you adjust the steering dual



◀ The Airtronics Caliber is the first pistol-grip radio with LCD display to hit the U.S. Like the older CS2P, its configuration is reversible for left- or right-hand operation.

rate with a flick of your thumb, and a wheel-tension adjust-

ment enables you to tailor the steering wheel's touch to your needs.

The 3P comes with a direct-servo-connect (DSC) cord that enables you to perform trim functions (without transmitting a signal) by plugging the radio directly into the receiver. This is an invaluable trackside feature because you can modify speed-controller or steering settings without interfering with other drivers. Two 94102 servos that are suitable for most R/C car and boat applications are also included.

The 3P is attractive because many of the frills (e.g., Ni-Cd batteries and servo upgrades) that make radio systems so expensive are available as

options. In addition, it's an FM system—very reliable, yet less expensive than a PCM system.

The 3P's optional servos have proven themselves to be the best in the business. From the ultra-quick, 94143 servo for 1/12 scale to the behemoth 94152 "this-will-take-anything" servo, you simply can't match their performance (although their cost is pretty tough to swallow).

The 3P offers the best of both worlds: it can be an economical high-performance radio system for beginners or a super high-tech system for the most discriminating racers.

Specifications

TRANSMITTER: Airtronics Caliber 3P

Operating system	3-channel pistol grip
Frequency module	93827
Transmitting frequency	27MHz and 75MHz
Modulation	FM
Power requirement	9.6 volts to 12 volts
Current drain	225mA

RECEIVER: 92736

Receiving frequency	27MHz and 75 MHz
Intermediate frequency	455kHz
Power requirement	4.8 volts to 6 volts
Current drain	18mA
Dimensions	1.80x1.125x0.75
Weight	1 ounce
Receiving range	330 yards on the ground

SERVOs

Control system	variable pulse width (1 to 2ms)
Operating angle	90° (45° each side)
Power requirement	4.8 volts to 6 volts
Current drain	10mA at 5 volts (idle)

Model	Output Torque	Operating Speed	Dimensions	Weight
94141	45.0 oz./in.	0.25 sec./60°	1.37x0.60x1.27 in.	1.18 oz.
94143	32.0 oz./in.	0.08 sec./60°	1.37x0.60x1.27 in.	1.08 oz.
94151	75.0 oz./in.	0.08 sec./60°	1.55x0.80x1.50 in.	1.90 oz.
94152	105.0 oz./in.	0.12 sec./60°	1.55x0.80x1.50 in.	2.40 oz.

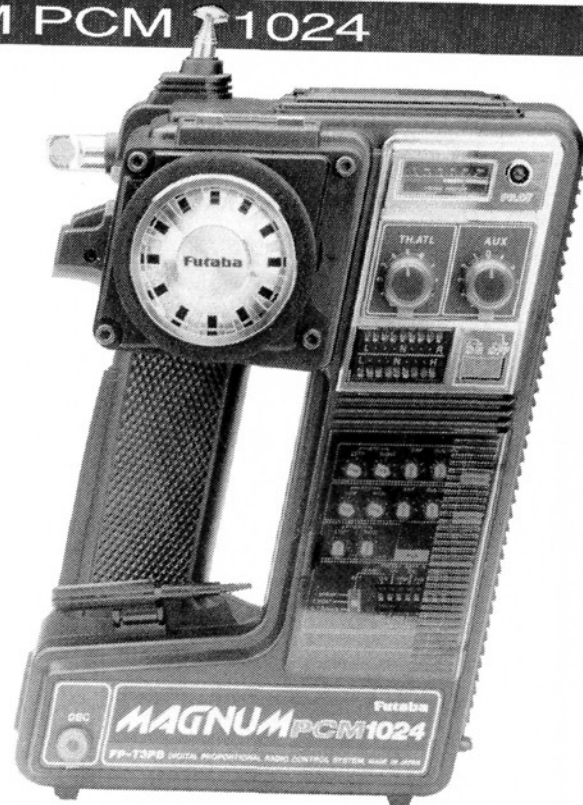
The Futaba Magnum PCM 1024 (part no. FP-T3PB) is the "cost-is-no-object" granddaddy pistol-grip R/C surface system. At \$450 to \$500, its price exceeds those of most 1/10-scale race-car kits, yet it has found its way into the hands of many racers, from the local to the world-championship level.

The letters "PCM" stand for pulse-code modulation, which refers to the way this system transmits its signal to the receiver. The PCM transmits an FM-based pulse code that, in its simplest form, can be referred to as a "binary digit code." This signal is interpreted by a micro-

processor receiver that directs the servo/speed controller. The beauty of the PCM is that it's immune to all but the strongest interference.

The Futaba PCM's ergonomics leave a lot to be desired: it doesn't have provisions for left-hand operation; its medium-size grip is slightly too large for small hands; and its hideaway-trigger design makes it uncomfortable for large hands (then again, F-16 fighters aren't built around their pilots). Nevertheless, you'll find racers of all sizes doing what they can to get their hands into the PCM.

The PCM doesn't have many electronic



The Magnum PCM—the big daddy of the top guns—was the first (and is still the most popular) "super" radio.

adjustments. Instead, most of its functions are controlled by mechanical switches and potentiometers. Although these aren't as precise as electronic adjustments, some people argue that they're better because they're easily accessible.

Tucked behind the Magnum's smoke-gray door, you'll find left and right ATV (adjustable travel volume) to limit left and right servo travel independently; exponential to modify servo response in relation to control movement; and sub-trim for steering and throttle. There are also several mixing functions to blend the auxiliary, third channel's actions electronically with one of the other channels (e.g., adding rudder on boats under accelera-

tion to prevent the effects of torque-steer!). Another switch allows you to change the radio's transmission from pulse-code to standard FM. Also tucked behind this door is a small control panel with micro-switches that are used to perform routine servo-reversing functions and to adjust the options for the built-in fail-safe function.

If the radio's receiver is ever affected by interference, the Magnum's fail-safe function gives you several options. One mode will prevent the car from running away if the receiver pack loses power (a common occurrence with gas-powered cars). If the voltage drops below a certain point, the radio will automatically return the servos

Specifications

TRANSMITTER: Futaba Magnum PCM 1024 (FP-3PB)

Operating system	3-channel pistol grip
Frequency module	FP-TL-FM
Transmitting frequency	27MHz, 29MHz, 40MHz, 72MHz or 75MHz
Modulation	FM, PCM/PPM selectable
Power requirement	7 pen-cell batteries (10.5 volts) or one 9.6V Ni-Cd battery pack
Current drain	200mA

RECEIVER: Miniature 3-channel PCM (FP-R113IP)

Receiving frequency	27MHz, 29MHz, 40MHz, 72MHz or 75MHz
Intermediate frequency	455kHz
Power requirement	4.8 volts to 6 volts
Current drain	16mA
Dimensions	1.68x1.13x0.63 inches
Weight	0.74 ounce
Receiving range	330 yards on the ground (approx.)

SERVOES

Control system	positive pulse-width control (1520µs neutral)
Operating angle	90° (45° each side)
Power requirement	4.8 volts to 6 volts (shared with receiver)
Current drain	12mA at 6 volts (idle)

Model	Output Torque	Operating Speed	Dimensions	Weight
FP-S9601	33.3 oz./in.	0.15 sec./60°	1.22x0.63x1.19 in.	1.09 oz.
FP-S9401	44.4 oz./in.	0.16 sec./60°	1.59x0.79x1.40 in.	1.76 oz.
FP-S9301	69.4 oz./in.	0.22 sec./60°	1.59x0.79x1.40 in.	1.76 oz.
FP-S3301	111.0 oz./in.	0.19 sec./60°	2.33x1.13x1.46 in.	3.32 oz.
FP-S132H	25.0 oz./in.	0.13 sec./60°	1.46x0.71x1.20 in.	1.13 oz.

TOP TRANSMITTERS

to a pre-set position using the battery's remaining power. Also included is a signal fail-safe option that will return the servos to a pre-set position and hold them there for .5 second.

The Magnum also features several external trim adjustments (all within "thumb's reach") with separate LED indicators. These exterior controls are placed strategically to allow on-the-fly adjustments without the threat of over-compensation that's common with wheel-type adjusters. Just above the LED

indicators are a pair of knobs for throttle ATL (adjustable throttle limiter) and third-channel trim. On the early systems, you adjusted the third channel at the control panel, but at the request of modelers, this trim was moved to the radio's exterior so that it would be easily accessible.

To limit the steering wheel's throw, you can adjust its angle, and it has a spring-tension adjustment to modify its sensitivity. On the hand grip, just behind the steering wheel, there's a thumb-wheel adjustment for steering dual rate, and it simultaneously limits steering travel. The dual-position trigger adjustment is on the

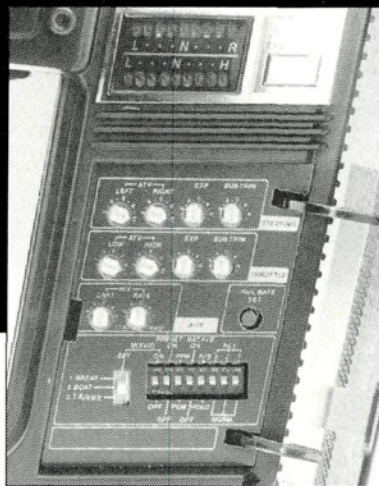
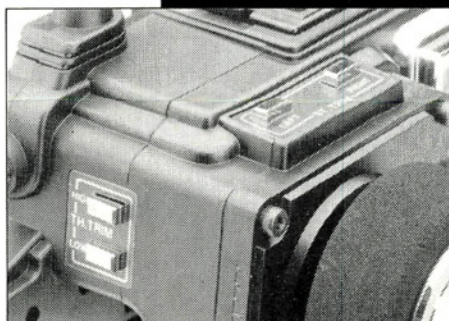
back of the radio. You can adjust the trigger for half throttle and half brake or two-thirds throttle and one-third brake (a setting that's used by many racers).

The transmitter also comes with a Ni-Cd battery and a removable RF module that permits frequency changes. The radio comes with a Ni-Cd battery charger, a hand strap, a PCM micro receiver and servos. There are three types of servo from which to choose, and your choice will affect the



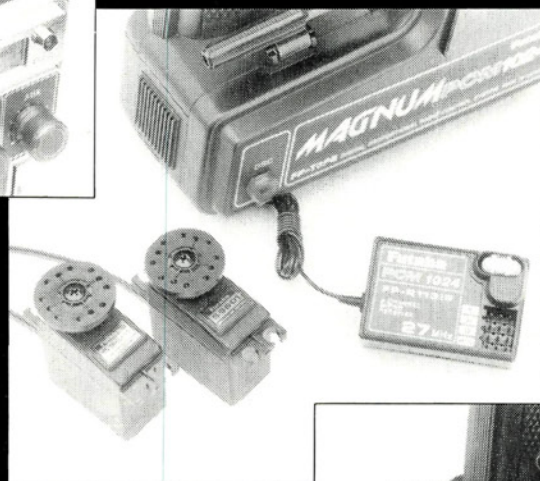
radio's final price.

Because most of the possible goodies (except for a DSC cord!) come with the Magnum PCM 1024, it doesn't have many optional accessories. Despite this radio's seemingly prohibitive cost, it's one of the most popular racing radios available.



Above and left: the throttle-ATL and the auxiliary-channel dials are covered by a plastic boot that prevents their settings from being changed accidentally. The battery-voltage indicator has an analog display, and the easy-to-read trims are shown on the two-color LED to the left of the on/off switch.

The Magnum's RF module is on the top of the transmitter.



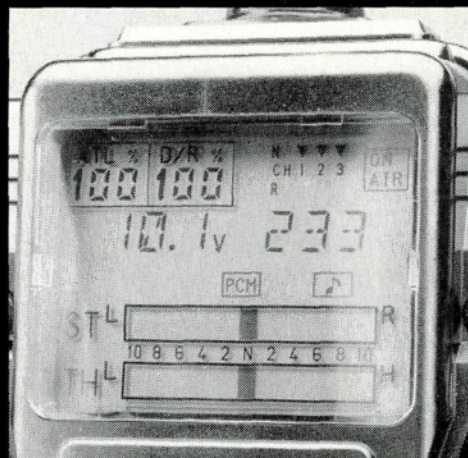
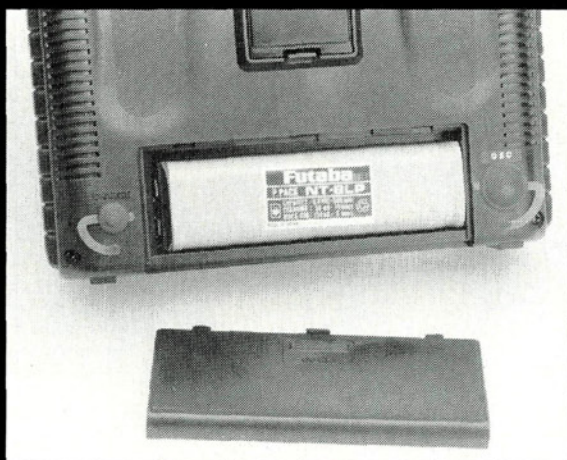
The Magnum PCM comes with the FP-R113iP receiver and a choice of 9601, 9301, or S132 servos.



Above: the Magnum comes with rechargeable Ni-Cds and a charger. ■ Left: the Magnum's trim adjustments are conveniently located within thumb's reach for "on-the-fly" trim changes.

TOP TRANSMITTERS

FUTABA FIELD FORCE 3 PCM 1024



Below: Futaba's latest and greatest radio—the Field Force 3—is different from the company's other radios because it's a twin stick instead of a pistol grip. ■ Above: instead of eating a hole in your wallet with alkalines, the FF3 includes Ni-Cds. ■ Above right: the LCD display lets you monitor all the FF3's vital functions at a glance; you can do everything but play Space Invaders on it! Notice that a digital battery-power display replaces the conventional analog display. ■ Below right: The RF module is on the back of the radio, out of harm's way. For increased comfort, the "finger-rest" area is recessed.



The Field Force 3 (part no. FP-T3UCP) is Futaba's latest offering, so it hasn't proven itself on the racing circuit yet. Its stick configuration, however, is bound to make

converted just to take advantage of this heavy hitter's huge selection of features.

The FF3 is a marriage of the technology that's used in the Magnum PCM and

that found in the Airtronics Caliber 3P—and then some. It has all the advantages of pulse-code modulation and a vast array of electronic control functions on an LCD control panel.

When you turn on the radio, you're greeted by a battery-voltage display and the timer tells you how long the radio has been

operating. From there, you can run through the features, which include: model selector (trim settings can be stored for up to six vehicles!); ATV to limit left and right servo movement independently; sub-trim; steering exponential; dual rate; ATL to limit braking; throttle-curve adjustment (similar to exponential); servo-

TRANSMITTER: Futaba Field Force 3 PCM 1024 (FP-T3UCP)

Operating system	3-channel stick type
Frequency module	FP-TP-FM
Transmitting frequency	27MHz and 75MHz
Modulation	FM, PCM/PPM selectable
Power requirement	9.6 volts to 12 volts
Current drain	200mA

RECEIVER: FP-R113iP

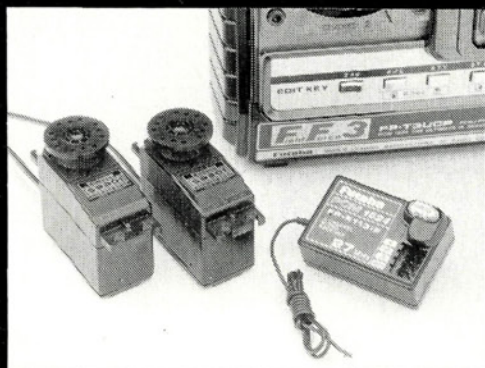
Receiving frequency	27MHz and 75MHz
Intermediate frequency	455kHz
Power requirement	4.8 volts to 6 volts
Current drain	16mA
Dimensions	1.68x1.13x0.63 inches
Weight	0.74 ounce
Receiving range	300 yards on the ground (approx.)

SERVO

Control system	positive pulse-width control
Operating angle	90° (45° each side)
Power requirement	4.8 volts to 6 volts
Current drain	12mA to 15mA at 6 volts (idle)

Model	Output Torque	Operating Speed	Dimensions	Weight
FP-S9601	33.3 oz./in.	0.15 sec./60°	1.22x0.63x1.19 in.	1.09 oz.
FP-S9401	44.4 oz./in.	0.16 sec./60°	1.59x0.79x1.40 in.	1.80 oz.
FP-S9302	99.0 oz./in.	0.19 sec./60°	1.59x0.79x1.55 in.	2.30 oz.

The throttle trims are on the side of the FF3, so you can adjust them easily during runs. The other adjustment switches are on the radio's top or on its face (rocker switches).



The FF3's receiver and servos are identical to those used in the Magnum PCM pistol-grip radio.

reversing; six third-channel mixing options (two of which are programmable); one-touch trim and ATL functions; neutral-position adjustment; data transmission; two fail-safe modes (similar to those on the Magnum); modulation that allows you to switch the radio from pulse-code to FM operation; buzzer

mode to change the internal beeper's tone or to shut it off; servo-display operation to monitor servo movement; all-clear to return the trim settings for any of the six models to their original default positions; copy to transfer data from one model selector to another; model data recovery; and—to top it off—

stopwatch mode.

The functions are controlled by the eight buttons that are located along the bottom of the radio's faceplate. You can also use quick-access keys for some of the commonly used functions, and this makes flipping through each display window unnecessary—perfect for situations when time is of the essence! On the radio's top, front and sides, there are one-touch buttons for steering dual rate, throttle ATL, steering trim, throttle trim and the stopwatch.

The FF3 also comes with a Ni-Cd battery and a removable RF module that allows you to change the band and the frequency. It has provisions for a DSC and a trainer cord, so if things get

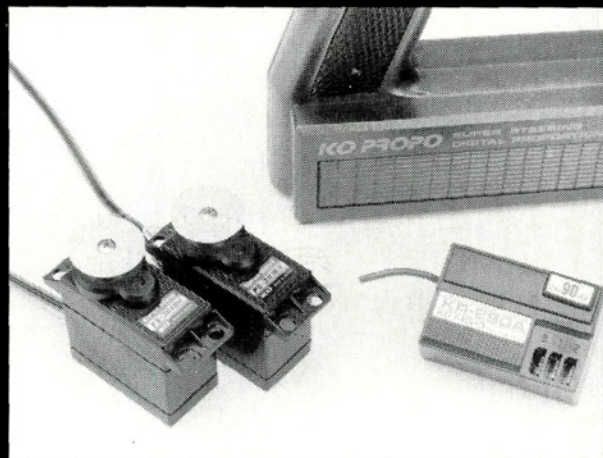
out of hand, an experienced driver can take control using a similar radio system. You have a choice of two servos, and both are the best Futaba has to offer. A standard PCM receiver, a Ni-Cd battery charger and a strap are also included.

With technology like this available, you might be ready to run to the nearest hobby shop to pick up an FF3, but hold on to your wallet! Space-age stuff like this isn't cheap. Costing \$560 to \$610, the FF3 has just replaced the Magnum PCM as the most expensive radio on the market. Rest assured, however, that the FF3 is the most advanced radio system available—hands down! If you can bear its price, you won't be disappointed.

TOP TRANSMITTERS



KO PROPO EX-1



▲ The standard EX-1 comes with two general-application PS-301BH servos and a KR-290A receiver. A CX-IV ESC and other servos (including the world-champion PS303-FET servo) are available as options.

◀ Although the KO Propo EX-1 is one of the more conventional radios, its superb ergonomics and ample trim functions have made it the choice of many top drivers.

Specifications

TRANSMITTER: KO Propo EX-1

Operating system	2-channel pistol grip
Frequency module	EX-1 TX
Transmitting frequency	27MHz and 75MHz
Modulation	AM-PPM
Power requirement	9.6 volts to 12 volts
Current drain	175mA

RECEIVER: KR-285A

Receiving frequency	27MHz and 75 MHz
Intermediate frequency	455kHz
Power requirement	4.5 volts to 6 volts
Current drain	8mA
Dimensions	2.05x1.14x0.63 inches
Weight	0.88 ounce
Receiving range	300 yards on the ground

SERVO

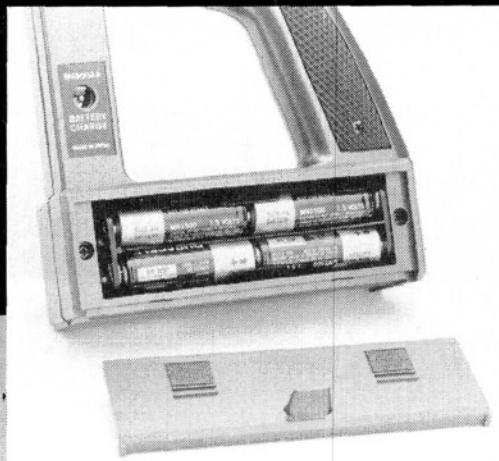
Control system	pulse-width control (1.55ms neutral)
Operating angle	±50°
Power requirement	4.5 volts to 6.3 volts
Current drain	12mA at 6 volts (idle)

Model	Output Torque	Operating Speed	Dimensions	Weight
PS-301BH	34.0 oz./in.	0.30 sec./70°	1.57x0.34x0.83 in.	1.59 oz.
PS-901BH	25.0 oz./in.	0.19 sec./60°	1.42x1.18x0.70 in.	1.20 oz.
PS-303FET	78.0 oz./in.	0.10 sec./60°	0.83x1.38x0.61 in.	1.94 oz.

The KO Propo* EX-1 is, without a doubt, the "dark horse" of the radios reviewed here. It's the only system in this hallowed group that transmits on AM, and it has fewer features by comparison. Still, some of the most talented racers in the world, including world champions Chris Doseck and Joel Johnson, have used the EX-1 time and again.

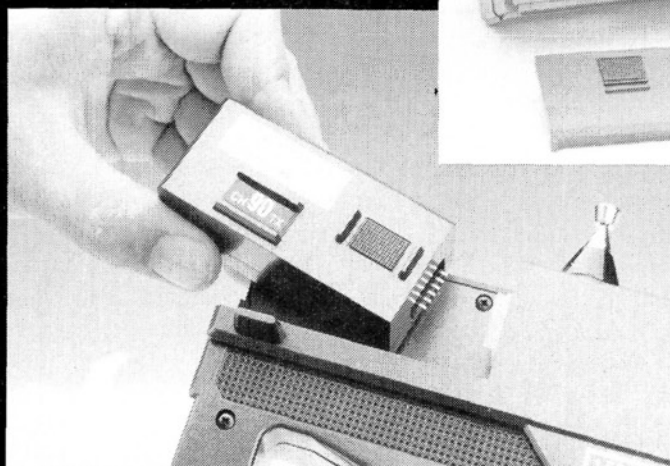
The system's appeal seems to result from its well-engineered design. Its simple, yet effective, transmitter has the best balance of the bunch. The battery

The EX-1's RF module is on the back of the radio. When you change the crystals, KO Propo recommends that you change the module, too. ▼



◀ The EX-1 has the conventional ammo-clip battery-loading setup. Note the built-in jack for recharging Ni-Cds.

The EX-1 has all the adjustments that you need to be competitive at any level, and they're concealed behind a panel, so an errant hand won't accidentally disturb them. ▼



area (Ni-Cds aren't included) is directly below the bulk of the upper portion of the transmitter. This keeps all the transmitter's weight as centered as possible. Its open-grip design also alleviates driver "claustrophobia," and its trigger action is very smooth, so you don't have to fight the return springs.

Behind the control-panel door, the radio's features include throttle high-point and exponential adjustments, independent left and right steering end-point adjustment

(EPA), steering sub trim, exponential (referred to as "super steering control") and servo-reversing switches for both channels.

The quick-adjustment levers for steering trim, braking trim and throttle trim are near the steering wheel, and there's a thumb wheel at the top of the pistol grip for steering dual rate. The EX-1 also has an interchangeable module that allows you to use the radio on 27 band or 75 band. The EX-1 is available in three versions: the Standard (featured

here); the Off-Road, which includes a KO CX-IV electronic speed controller and the awesome PS-303 FET-booster servo; and the On-Road, which comes with the CX-IV controller and a KO PS-901BH high-speed miniservo.

Although the EX-1 is basic, it's popular in the racing community. It has enough of what's needed to perform most critical trim functions, without the confusion of a lot of bells and whistles. The EX-1 also gets a gold star for being the most economical (by far!)

radio in the group.

These systems are all topnotch racing radios, and they cover the spectrum from basic to outrageous. They top the charts in their respective classes, and none of them will let you down. The variety of prices means there's one to suit every racer.

**Here are the addresses of the companies featured in this article:*

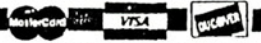
Futaba Corp. of America, 4 Studebaker, Irvine, CA 92718.

Airtronics Inc., 11 Autry, Irvine, CA 92718.

KO Propo; distributed by Global Hobby Distributors, 10725 Ellis Ave., Fountain Valley, CA 92728. ■

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TEKIN PRO DYNO

(Continued from page 41)

track performance, and it has nothing to do with the motor's power output. Essentially, rpm dictate the gear ratio needed to make use of a motor's power. For example: two motors that have the same power reading may yield different rpm ratings, in which case the gear ratios must be adjusted to achieve the same final axle speed. The motor with the higher rpm will have to be run with a smaller pinion gear than the motor with the lower rpm rating if it's to perform efficiently, i.e., accelerate the car quickly and achieve and hold optimum top speed.

The third motor rating given by the Tekin Pro Dyno is the no-load amp draw. To get this reading, detach the test motor from the slave-motor coupling and slide the motor free of it. With the dyno on "manual," turn the test motor on and adjust the voltage to 5. Next, switch the display so that it's reading amps. This is the no-load amp-draw reading.

Record all three of these figures, compare them with those obtained with other motors and with your motor when you test it again. The difference will be a good indication of the motor's deterioration.

WINNING SPIN

What do all these readings mean? Simply

put, the motors with high power ratings will be the quickest and will accelerate faster. Motors with the lowest amp draw will be the most efficient. The key to racing success is to find motors with the best overall combination of these two traits. If you have two motors with equal power ratings, the one with the lowest amp draw will be the motor to use, as it will be capable of producing the same horsepower as the other motor, but it will use less energy doing so. This motor is more efficient.

I can verify Tekin's claims about the Pro Dyno's accuracy. For the first few weeks that I used it, I used a home-built

(Continued on page 82)

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TEKIN PRO DYNO

(Continued from page 78)

slave motor, because the pre-built-and-tested Tekin unit wasn't available. Tekin then sent me one of their new slave motors, so I switched to it. I'm pleased to report that I tested the same motor on the dyno with both slave motors, and the tests yielded identical results.

Is the Tekin Pro Dyno worth the investment? The answer depends on how serious a racer you happen to be. If you've only been racing for a season or two, spend your money on batteries, and go practice! If, however, you're a fairly accomplished racer—one who's capable of understanding (and using) the information provided by a device such as the Pro Dyno—I strongly recommend that you pick one up. Feature for feature, you'd be hard-pressed to find a comparable professional dyno for the money.

*Here's the address of the company featured in this article:

Tekin Electronics, 970 Calle Negocio, San Clemente, CA 92672. ■

HEMI COUPE

(Continued from page 52)

COME TOGETHER

Bringing the body, engine and chassis together for the first time is more exciting than Pontiac could ever have known! It looked great, and I must have studied and admired it for an hour before I took it out for its test ride and pictures.

The car's first trip around the parking lot was a little disappointing; its acceleration could have been timed with a sun dial! Then I discovered that I had created an unlimited-slip differential by not tightening the right rear wheel's hub nut sufficiently. A few quick turns clockwise had

(Continued on page 88)



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HEMI COUPE

(Continued from page 82)

the coupe boogying across the blacktop at a much more respectable clip.

Next came the handling. There's little to do in this department. In keeping with the kit's simplicity, front-end toe-in is about all you can adjust. You could probably experiment with front spring rates, but I doubt that would yield much benefit. Besides, the car is for running, not racing!

With the Hemi coupe, Parma has provided an R/C car for scale enthusiasts to enjoy. Its uncomplicated, unsophisticated design is just the thing to ensure "fun running" for a long time. With a parts count that's low enough to keep things simple and easy to maintain, this kit has none of the temperamental, sometimes finicky, characteristics of some more expensive, "higher-tech" offerings. All this means that you'll spend more time on the road than in the pits. Maybe someday the pit dwellers will learn what *real* fun is!

**Here are the addresses of the companies mentioned in this article:*

Parma, 13927 Progress Pkwy., N. Royalton, OH 44133.

(Continued on page 111)

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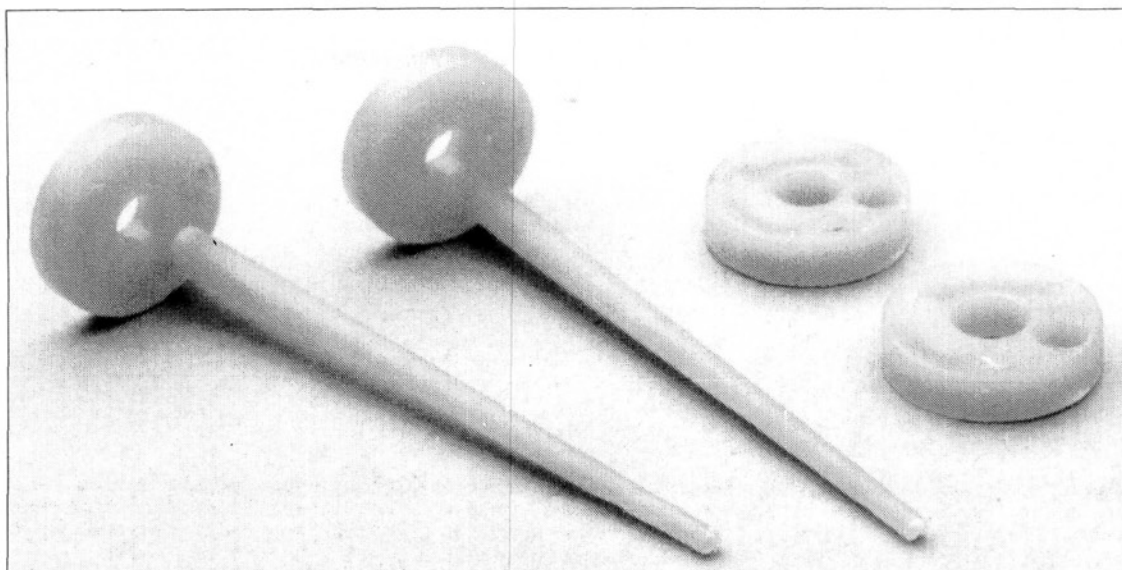
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For progressive damping, Paragon's Jump Jets use a singlehole piston and a needle.

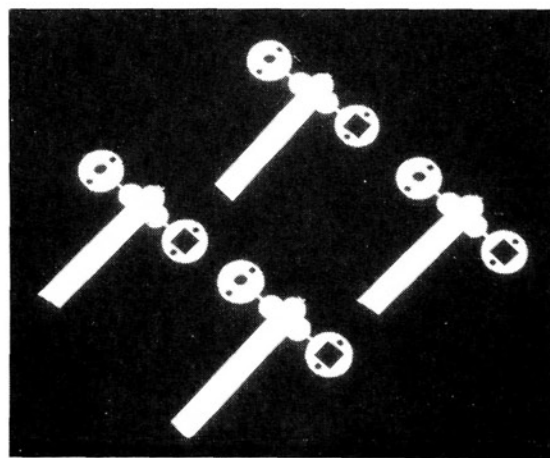


New shock technology

MOST PEOPLE DON'T realize that there's a lot more to shock technology than selecting the right oil. Thin or thick, the oil's viscosity remains the same throughout the suspension travel, i.e., damping is constant from start to finish—under compression and during rebound. Two companies have developed methods to alter this type of damping, and both are worth checking out.

PARAGON JUMP-JETS

Paragon's* Jump-Jet consists of a



T.M. Racing Components' Valve-A-Matics are two-piece units that provide dual-rate damping.

dynamic DAMPING

by JOHN HUBER

tapered needle and a single-hole piston. The needle is submerged in oil inside the shock body. The piston is mounted on the shock shaft with E-clips, and the needle passes through the hole. During compression and rebound, the piston travels along the tapered needle. At full extension, the amount of damping is very small, since the portion of the tapered needle within the piston is very thin. As the shock compresses and the piston travels up the needle, the rate of damping increases because the hole in the piston becomes restricted. This is known as a "progressive damping system," or as Paragon calls it, "variflow."

With this method, the damping is very light and responsive when a car trav-

els on a track with small undulations, but it also provides the heavier damping that's required to recover from larger jumps when the shocks have been fully compressed. The action is still adjusted with the shock oil's viscosity, but you'll probably need a lighter-than-usual oil for proper operation. Jump-Jets are available for Associated, Kyosho and Losi shocks.

T.M. VALVE-A-MATICS

The Valve-A-Matic from T.M. R/C Racing Components* uses a two-piece piston that alters the damping in either direction of travel. One part of the piston resembles a standard piston, but it's thinner and has a raised square section around the hole in the center (Part A). The other part (Part B) has a square opening in the center that fits onto the other piston. Both pieces have two oil-passage

(Continued on page 104)

DAMPING

(Continued from page 103)

holes. Part A is held tightly to the shock shaft with E-clips. Part B, however, floats slightly on the other piston, with its holes 90 degrees from those on Part A. The two pistons come together (sealing the holes) in one direction of travel, and will separate (opening the holes) in the other direction of travel. This achieves different damping characteristics during compression and rebound.

In most cases, you want more damping on the compression stroke and a quick rebound. The instructions included with these pistons tell you to set them up for light damping under compression and a slow return time, but this doesn't usually work well. It creates a condition referred to as "suspension packing." When your car or truck approaches a series of bumps, the contact with the first

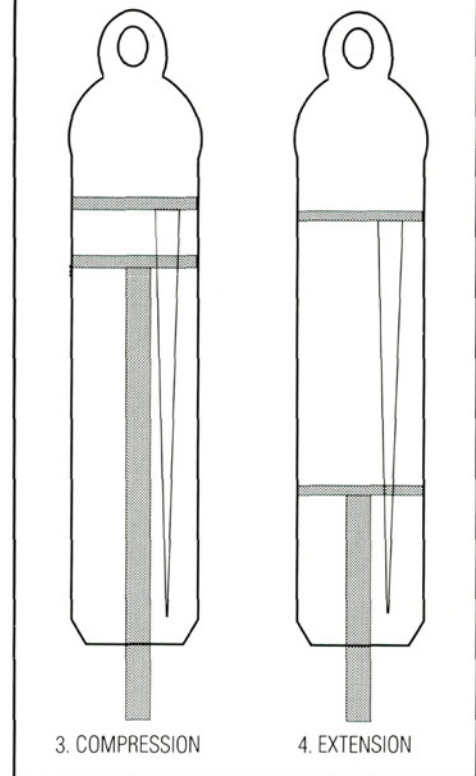
bump will compress the shock. Because damping is heavy on the rebound, the shock may not recover completely before hitting another bump, and this compresses the shock even further. Another few jumps, and the suspension will be packed to the point where it has bottomed out.

I modified a set of pistons slightly to alter their response by drilling two more holes into the floating piston and flipping the pistons around so that the floating piston was on top. During compression, two holes are left free for oil transfer, but during rebound, four holes are open. This method allows you to use a thicker shock oil than the suggested 5WT. With the new holes, 20WT seemed to fit the bill. Filing a small notch in the edge of the two pistons yields similar results. T.M. shock pistons are available for Associated, Kyosho and Losi shocks.

Now, I can't say one system is better than the other; you'll have to determine that with your experiments on your track. I've used both designs, and each serves a purpose. Paragon's Jump-Jets seem better suited to tracks that have smooth sections as well as large jumps. There's no change in the compression/rebound damping ratios, just an increase in how progressive the damping is. The shock simply gets harder to compress through the range of suspension travel.

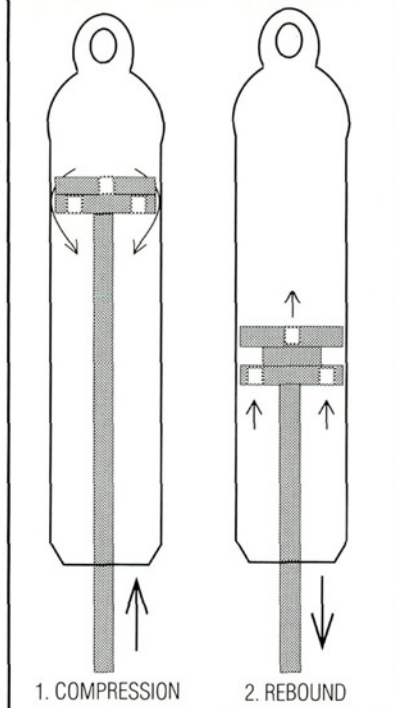
T.M.'s Valve-A-Matics seem to work better on tracks that have bumpy surfaces and moderate jumps. This system differs in that it changes the amount of damping there will be under compression versus rebound. For instance, out of the 100-percent effort required to cycle the shock

PARAGON JUMP JETS



- 3. When the Jump-Jets are compressed, the fattest part of the needle moves into the hole, providing the most restriction. The damping rate increases progressively as the shock is compressed.
- 4. The thinnest part of the tapered needle is in the piston's hole when Paragon Jump-Jets extend. This provides the least restriction.

T.M. VALVE -A-MATICS



- 1. During compression, the Valve-A-Matic's two pistons meet, and their holes are sealed. Oil passes around the pistons rather than through their holes.
- 2. As the shocks rebound, the Valve-A-Matic's two pistons separate. The holes are uncovered, and oil can pass through them freely.

once, 70 percent may be required for compression while only 30 percent is needed for rebound. The "feel" you want will determine the system you'll choose.

Both systems are inexpensive, so you can easily experiment with variable damping without taking out a loan. In either case, the merits of variable damping are worth looking into. Just ask someone who knows about damping on full-size race cars or bikes. Not many racers of full-scale vehicles use shocks with constant damping rates—why should you?

**Here are the addresses of the companies featured in this article:*
Paragon Racing Products, 690 Industrial Cir. S., Shakopee, MN 55379.
T.M. R/C Racing Components, 39330 Donahue, Mt. Clemens, MI 48044.

NITRO NEWS

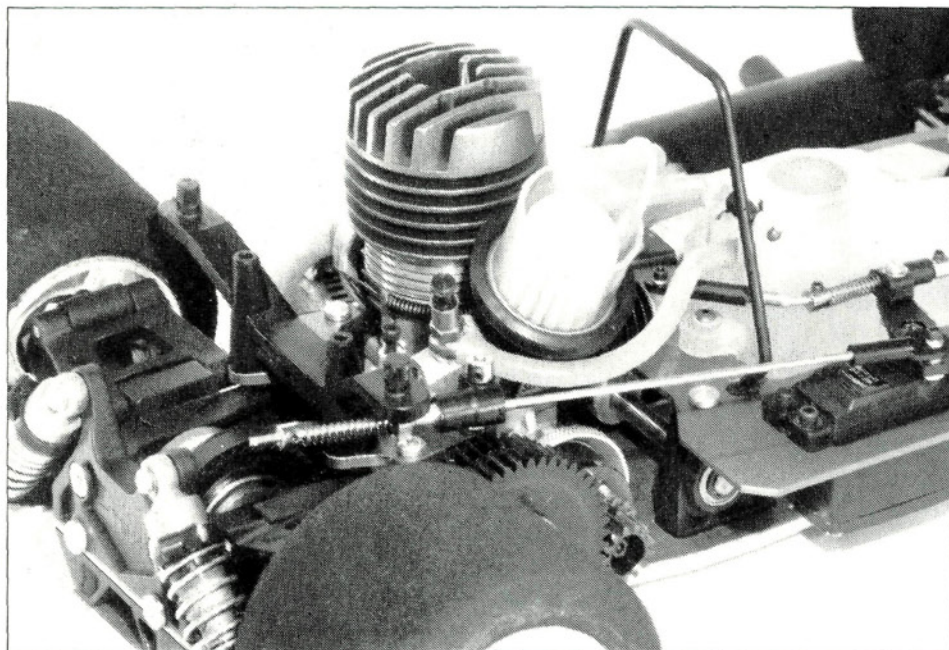
by JEFF BRONSTEIN

1/8-scale on-road anatomy

THE PRINCIPAL difference between gas and electric cars is obvious—the source of power. The cars themselves are very similar, but a gas car's layout has everything to do with how well it performs. Both on- and off-road gas cars use a fully independent, four-wheel suspension, similar to that of most 1/10-scale, off-road buggies and trucks. Chances are, however, this would be the only thing that most electric racers would recognize.

Gas cars aren't really that complicated. Since I race a Serpent* sprint car, I'll use it as an example of a 1/8-scale, on-road racer. Other kits differ slightly, but their basic layouts are still the same.

Like most cars, it's imperative that the chassis has a rigid, front, impact bumper that can withstand the torture of the occasional miscalculation. (Hitting a board at 60mph is no fun.) Directly behind the bumper assembly is the front anti-sway bar and the front upper and lower A-arm supports. Serpent's car uses a unique, cantilevered, front sway bar and, although it's difficult to adjust, it works very well.



The throttle servo on gas cars operates the carburetor and the brake. The springs on the control rods override the carburetor when brakes are applied.

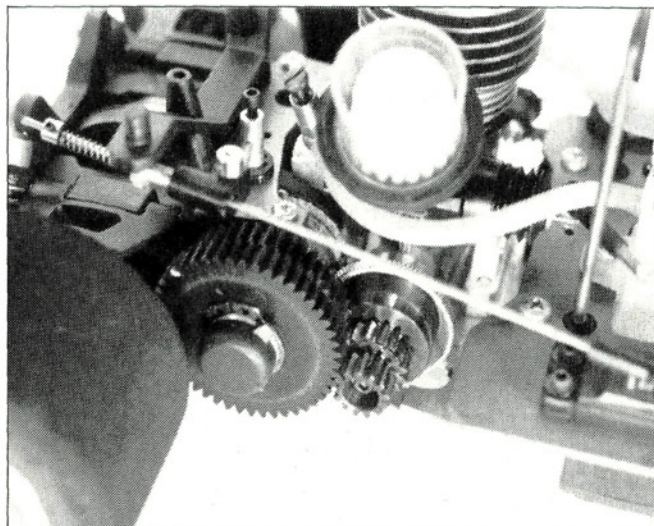
Front anti-sway bars aren't used frequently on electric-powered cars, but they're almost always used on gas-powered, on-road cars to minimize body roll in cornering.

A small amount of movement in the suspension pivots provides limited suspension adjustments: some caster and, for the most part, only minimal camber adjustment. Although this simplifies the suspension geometry, it hinders ingenuity. Four-wheel-drive cars use extra caster to help the front-wheel drive pull the car through corners, so converting to two-wheel drive may require redesigning the upper A-arms to decrease caster.

Except for the Delta* P2, most 2WD cars are 4WD kits without the front-drive system. Inside the

4WD front wheel-bearing carriers, or on the 4WD axle, is the one-way bearing system that allows the front wheels to free-wheel. This means that the rear tires do all the work until they lose traction, e.g., in a corner; then the front-drive system kicks in and pulls the car through the corner. As long as the rear tires have traction, the fronts merely spin freely. As you might guess, the tires' diameters, both front and rear, are critical in determining the F/R drive ratio.

The front-suspension shocks and springs are mounted directly behind the front-suspension arms. The shocks are usually the high-quality, anodized, aluminum type, and some have internal variability. Both Serpent and PB* have developed a new, front-suspension assembly with horizontally mounted shocks that use a cantilever to increase shock-piston travel versus suspension travel, and thereby improve their damping. The jury is still out on their effectiveness, but they look "trick" on the car. If nothing else, they psych out the other drivers.



A dual-gear system provides two gear ratios that are used automatically. When the car reaches a certain speed, the second spur gear engages, and the first "freewheels."

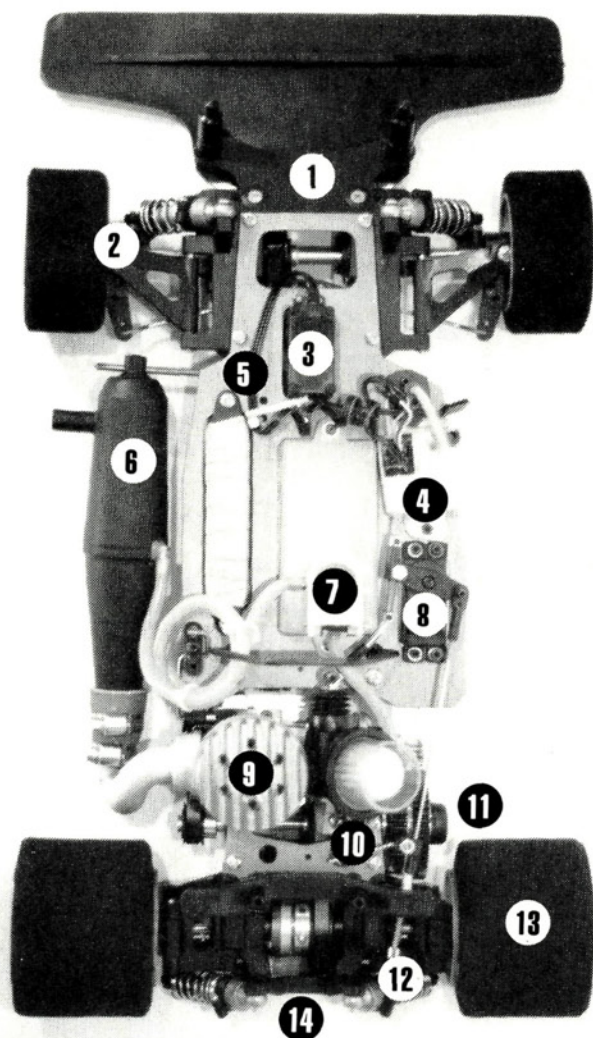
A "NARROW" CAR

Serpent is distributing a new "narrow" car that cuts 4mm off the front wheel base. Theoretically, this increases steering response. The rigidity of the car's aluminum or graphite chassis is improved by using an upper radio tray, where the servos, the receiver and the fuel tank are mounted. The front steering servo is mounted upside-down, with the servo-saver between the two trays. To minimize the effect that fuel usage has on the car's handling, the fuel tank is located at the car's roll center. The engine's exhaust system is mounted on the car's left side, and the outlet is near the front left tire. The pipe's length helps to determine the engine's overall power band, i.e., a shorter length improves high-end power, and a longer length improves the low-end. To offset some of the weight, the receiver, the receiver battery and the throttle servo are usually mounted on the opposite side of the engine. The throttle servo controls the carburetor and the disk-brake system. One of the simplest and most important features on a gas car is the throttle-linkage override. This lets the servo actuate the brake independently of the throttle, and allows the engine to idle while under braking.

Since the car is always influenced by acceleration, braking or cornering, the fuel is rarely sitting at the bottom of the fuel tank. Special pots at the bottom of the tank capture the fuel near the pickup. Several inches of fuel tubing connect the fuel tank to the exhaust pipe, and this allows the exhaust pressure from the engine to help push the fuel to the carburetor. On top of the fuel tank is a quick-fill, spring-loaded lid that can be opened with one finger, while the other hand quickly refuels the car. Using a special fuel gun, pit stops can be as short as two to three seconds.

The 3.5cc engine is mounted sideways behind the radio tray; the carburetor and air filter are on the right; and the exhaust manifold is on the left. A sturdy roll bar protects the engine, and it serves as a handle so that the pitman can grab the car for refueling. The enlarged heat-sink heads, which pop up through the car's body, help to dissipate the heat from the engine. Mounted directly on the engine's crankshaft is a centrifugal clutch that allows the engine to idle while the car is stationary. As the engine accelerates, the clutch engages the pinion assembly to drive the transmission.

More recent gas cars use two-speed transmissions that yield better acceleration without sacrificing top-end speed. This is probably the source of frustration for most beginners. The two-speed is actually one of the least complicated, low-maintenance components on the car. The tranny uses two sets of gears mounted onto a shaft behind the engine. The pinion gears are mounted side by side on the clutch bell. As the car accelerates, both sets of gears turn simultaneously. The two spur gears are also mounted side by side. One is on a one-way bearing and the other is on a centrifugal clutch like that used on the engine. The car accelerates on



1. The cantilevered front sway bar is protected by the front body-post assembly.
2. Nylon reinforced A-arms are rugged and provide limited suspension-geometry adjustment.
3. The steering servo mounts upside-down in the radio tray. The servo-saver and steering linkage work between the two chassis plates.
4. The receiver mounts on rubber grommets, which protect the delicate electronics from vibrations.
5. The chassis is made of aircraft-quality aluminum or graphite.
6. The muffler system uses engine-exhaust pressure to keep unburned fuel in the combustion chamber and to reduce noise.
7. The spring-loaded, quick-fill lid allows the pitman to refuel the car quickly.

8. Using a linkage-override system, the throttle/brake servo actuates the carburetor and the brake cam.
9. The 3.5cc engine develops 25,000 to 35,000rpm; the heatsink head helps to dissipate heat that's generated during combustion.
10. The slide carburetor meters fuel and air for the proper mixture to the engine.
11. The two-speed transmission improves acceleration and top end with two gear ratios. Shifting is automatic.
12. Top-quality, oil-filled shocks provide damping. Even a little bump becomes an obstacle at 60mph.
13. In long races, quick-change hub carriers let you make tire changes quickly.
14. The rear sway bar improves weight-transfer characteristics and traction.

the higher gear ratio to the point where the two-speed clutch engages inside the second set of gears. The second gear "shifts" in while the one-way bearing allows the

(Continued on page 110)

HEMI COUPE

(Continued from page 88)

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NITRO NEWS

(Continued from page 107)

first gear to free-wheel. Shifting is instantaneous, and when it happens these cars bust a move.

Depending on the traction, a straight axle or ball diff (similar to most 1/10-scale cars) is used on 4WD cars; 2WD cars usually use the ball diff to help improve steering. Like most electric-car diffs, the live axle can limit slip. If the diff is set too loosely, the heat that's caused by friction will quickly melt the entire diff assembly.

The front and rear suspensions are very similar. The shocks are mounted behind the A-arms, and the rear anti-sway bar is attached to the lower units. Some cars provide additional camber setting for different tire diameters but, for the most part, a neutral or slightly negative camber is preferable. Many cars also use a "quick-change," rear-wheel mounting system that

(Continued on page 164)

Fine Finishes



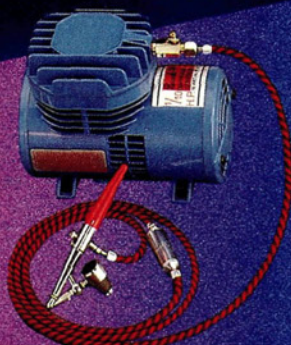
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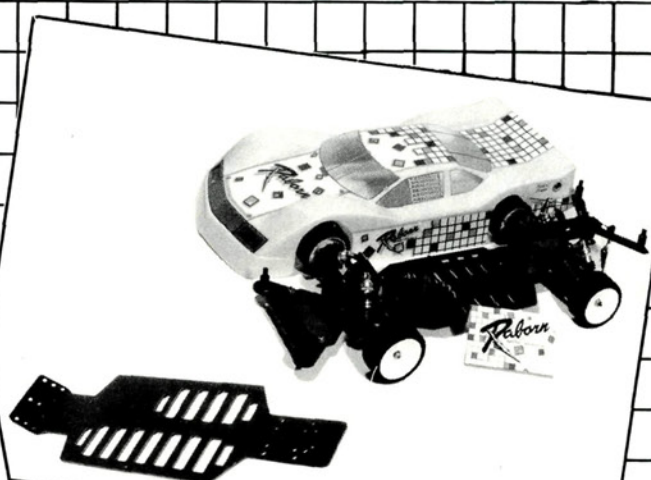
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Batteries

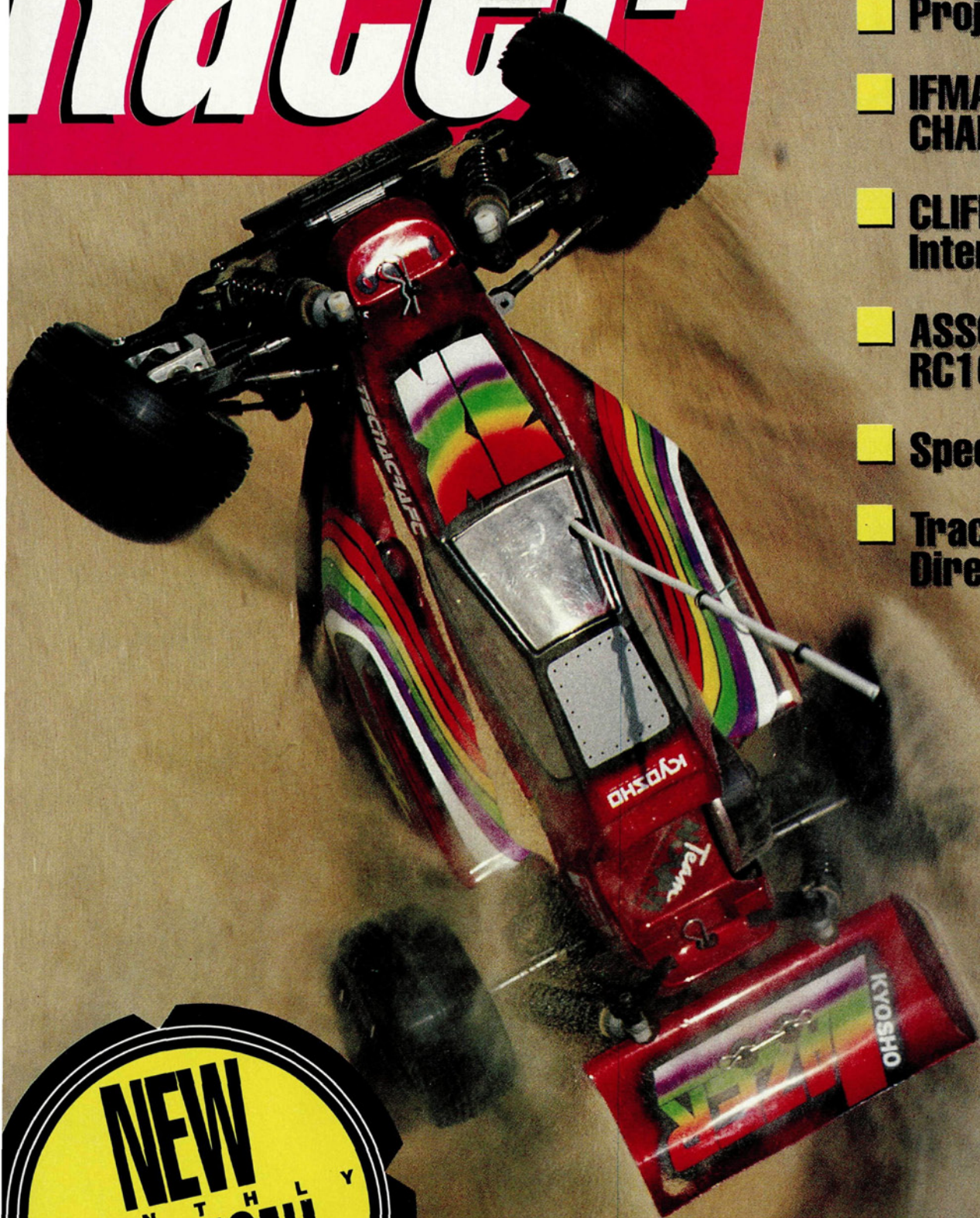
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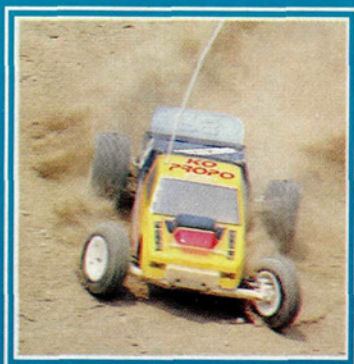


WELCOME TO R/C RACER!—the newest section in your favorite R/C magazine! As editors of the world's largest R/C car publication, we've spent plenty of time with our ears to the tracks, listening to you, our readers, and keeping a close eye on trends in the R/C industry. Since the first issue of *Car Action* hit the stands almost seven years ago, we've found that the mainstay of the hobby is the racer.

We introduce *R/C Racer* in recognition of the the dedicated competitors who brave the elements and the 16-hour race days for nothing more than the satisfaction of knowing they did their best—win or lose.

This special section will keep you, the racer, apprised of the latest speed secrets and hot new products from around the world, for every popular scale and type of racing. Each month, we'll feature full coverage of the biggest races; and there will be technical features to help you go faster for longer. What's more, this section will always include the most comprehensive R/C Track Directory ever published! And keep your eyes open for Track Reports on the latest offerings from R/C racing's hottest manufacturers. In short, *R/C Racer* has everything!

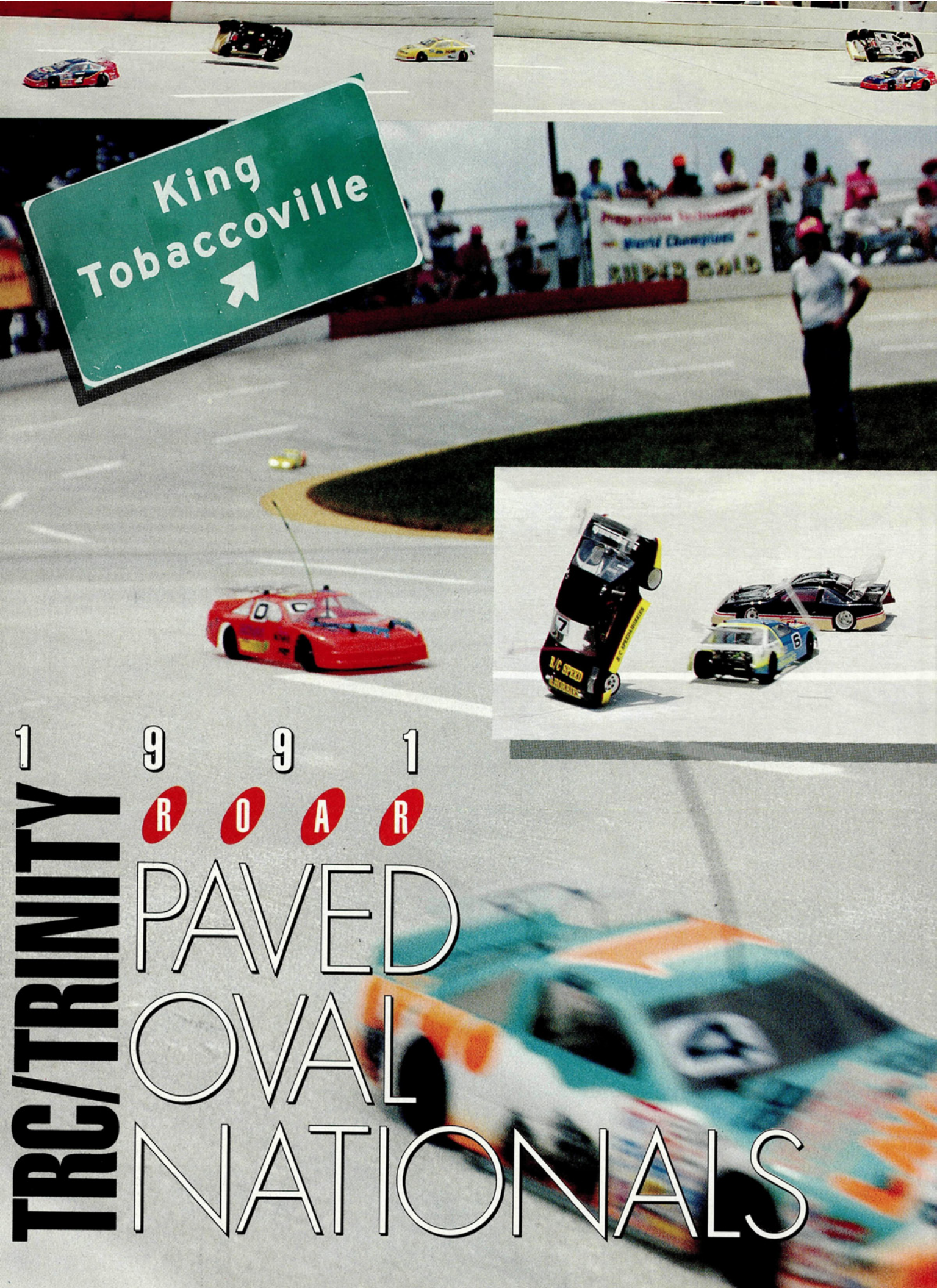
Remember, *R/C Car Action* is for you! And this new section is our way of letting all racers know that we haven't forgotten about them. This is our way of saying thanks for being there for us, so sit back and enjoy, and we'll see you at the track!



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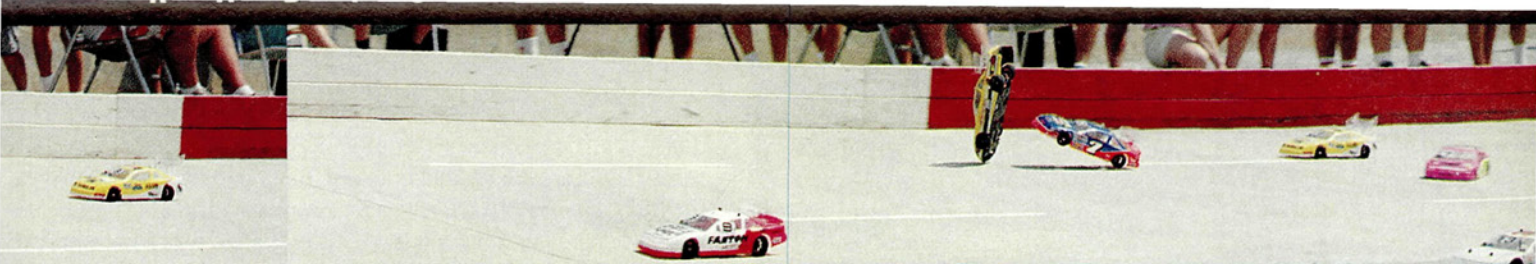


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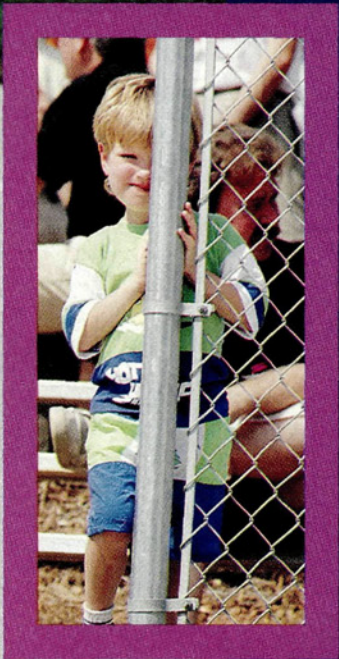
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TRC/TRINITY

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R O A R

PAVED
OVAL
NATIONALS



b y J O H N H U B E R



FOR 1991's ROAR Paved Oval Nationals, the country's best racers headed to PC Hobbies in King, which is about 15 miles from Winston-

Salem, NC, in the heart

of the nation's tobacco country.

On May 24 through 26, driv-

ers from as far west as California and as far

east as New York competed for the title of

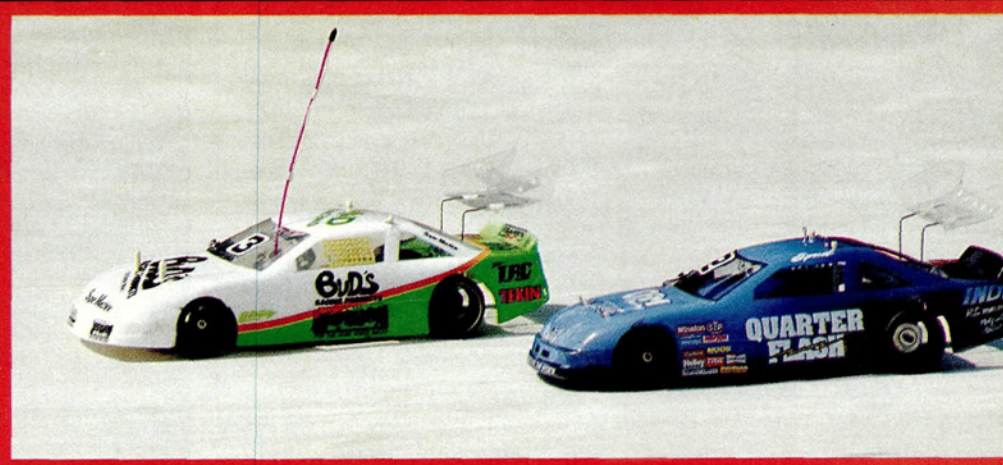
ROAR National Champion. Only four out of

more than 400 entrants would come away vic-

torious in their respective classes— $1/10$ -Scale

and $1/12$ -Scale, Stock and Modified.

Tobacco Road!





Diehard Drivers

What do a bunch of R/C racers do when the day's racing is over? That's right; they race some more! Many of the racers who attended this year's ROAR Nats found a little go-cart track near the hotel where they were staying. It was a fairly small, flat oval (much smaller than the one at PC Hobbies), but it was the perfect place to cool off and have fun after a day at the races.

At first, some of the go-carts seemed faster than

others, but out on the track, this wasn't the case. They were all equally powered, and their tires screeched around the turns. To pass other carts, the racers had to drive "the perfect line" around the track, and this wasn't easy. A few slammed into the tires of other carts—not at all by accident! These "races" were a good way to let off steam, and they really showed what diehard racing fans R/C car enthusiasts are.

PC Hobbies' large, tri-oval, concrete track is very well made and extremely smooth. Looming over one side of it, a huge drivers' stand has ample room for the drivers and all the transmitters. The tech area and the lap-counting officials' room are in the stand's lower level and, with the air-conditioning, I bet it was nice and cool in there! The temperature outside was hot, but bearable. John Thawley and Roy Weast of ROAR were on hand to officiate, and they did a great job.



Tony Davis (left) and Jeff Yost posing with their winning cars. Tony took first place in Concours; Jeff won the Best Paint category.

HOT LAPS

Organizing the qualifying races for an event of this size can be difficult. They're often arranged so that all the

"big" racers are grouped, and this is sometimes unfair. At this event, however, the drivers made solo runs of two "hot laps," the best of which would determine their qualifying heat. You'd think it would take a long time for 400 people to qualify, but the races were run on a very tight schedule. If a driver wasn't ready when his or her name was called, the officials simply moved on to the next name and called the unprepared racers again later.

At first, I had doubts about how accurate the qualifying races would be, but the system seemed to work. When the drivers ran the hot laps, they weren't concerned with run times, so most of

them ran using super-hot motors, SCR batteries and large pinions. The cars were much faster than they were during the practice runs, but the trick was that they had to be able handle the extra horsepower. Overall, the hot-lap system was a good way to set up the qualifying.

QUALIFIERS

On Friday morning, after the hot laps had been run, the qualifying got under way. The first was the 1/12-Scale Stock, in which Todd Putnam made his mark early with a 41-lap run. Tim Sykes and



1/12-SCALE STOCK

Fin.	Qual.	Name
1	1	Todd Putnam
2	2	Tim Sykes
3	4	Hoyte Stacey
4	3	Bill Rockenstyre
5	8	John Jenkins
6	6	Ernie Bucci
7	5	John Walters
8	9	Douglas Suggs
9	10	Jerry Adams
10	7	Tom Ickes



1/12-SCALE MODIFIED

Fin.	Qual.	Name
1	2	Chris Doseck
2	7	Warren Darby
3	1	Kent Clausen
4	8	Bud Bartos
5	3	Bob Hall
6	4	Terry Rott
7	5	Shawn Ireland
8	10	Chris Smith
9	9	Jim Fuller
10	6	Mike Reniger



1/10-SCALE STOCK

Fin.	Qual.	Name
1	1	Michael Murphy
2	2	Cary Poole
3	6	Tim Holland
4	4	Steve Roberts
5	7	Danny Monegan
6	3	Jason Harder
7	9	Jody Utt
8	10	Steve Schuyler
9	5	Brian Painter
10	8	Sam Nixon



1/10-SCALE MODIFIED

Fin.	Qual.	Name
1	2	Terry Rott
2	1	Chris Doseck
3	3	Chris Smith
4	5	Mike Boylan
5	9	Kent Clausen
6	7	Andy Dobson
7	10	Gary Warren
8	8	Tim Lanier
9	6	Kevin Lanier
10	4	Ralph Burch

Bill Rockenstyre were the only other drivers to complete 41 laps, and they followed Putnam in 2nd and 3rd places respectively.

There was fierce competition in the 1/10-Scale Stock Class, with the top five qualifiers separated only by fractions of a second. On the second day of qualifying, Michael Murphy captured the top spot with a 33-lap run. Following close behind were Cary Poole and Jason Harder.

Early on Saturday morning, the 1/12-Scale Modifieds took to the track. Compared with the stock-class cars, the modifieds seemed like rockets. Kent Clausen and Chris Doseck drove



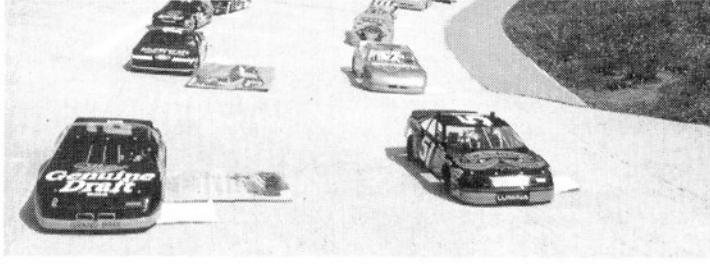
Behind this wall of trophies are PC Hobbies' Paul Covington and TRC's Tim Morton.

Laps	Time	Chassis	Motor	Batteries	ESC
41	5:06.63	Murphy X-22	Handout	Fantom/CAM	Tekin 411
40	5:00.04	Bolink LTO	Handout	B&T Racing/High IQ	Tekin 411P
40	5:05.53	Scratch-built	Handout	HRS Speed Systems	Novak 410-M1c
40	5:07.73	DA/Associated/Ugly	Handout	Ballistic	Novak
39	5:01.51	N/A	Handout	N/A	N/A
39	5:05.05	N/A	Handout	N/A	N/A
38	5:02.69	Bolink	Handout	PTI	Tekin
18	2:44.89	Bolink LTO	Handout	CAM	Novak
17	2:35.47	Bolink	Handout	CAM	Novak 410-MXc
12	2:34.69	DA Graphite	Handout	ESP	Tekin

Laps	Time	Chassis	Motor	Batteries	ESC
45	5:03.18	Associated	Cam Super Mod.	CAM Ace Pilot	Novak 410-M1c
45	5:05.23	Bolink LTO	East Coast	PTI	N/A
44	5:03.02	Associated 12L Oval	Reedy	Reedy	Novak
43	5:01.60	Associated 12L SS	Bud's	Power Pushed	Novak
43	5:02.21	Associated 12L	Fantom	Super Cell	Tekin
43	5:02.54	Bolink LTO	East Coast	East Coast	Novak 410-M1c
43	5:03.03	Associated Oval 12L	Reedy	Reedy	Novak
42	5:04.98	Bolink LTO	East Coast	King R/C Cells	Novak 410-M1c
41	4:56.63	Lynx	East Coast	PTI	Novak
41	5:03.59	OMJR	Fantom	Fantom Killervolt's	Novak

Laps	Time	Chassis	Motor	Batteries	ESC
33	4:06.99	Murphy D-22	Handout	CAM/Ballistic	Tekin 700
33	4:11.83	Lynx II	Handout	East Coast	Novak
32	4:01.65	Lynx	Handout	Endurance	Novak 410-M1c
32	4:04.51	Lynx/Roberts	Handout	PTI	N/A
31	4:01.66	Lynx II	Handout	Power Push	Tekin 600
31	4:06.57	Associated 10L	Handout	HRS Speed Systems	N/A
30	4:02.42	Lynx II SS	Handout	PTI	Tekin 700
29	4:04.30	Lynx II SS	Handout	Endurance Racing	Novak 410-MXc
9	1:12.94	Bolink	Handout	Mustang	Novak T-4
5	0:50.04	Lynx II SS	Handout	Floyd Batteries	Novak 410-M1c

Laps	Time	Chassis	Motor	Batteries	ESC
37	4:06.51	Bolink Narrow LTO	East Coast	East Coast	Novak 410-MXc
36	4:00.95	Associated 10LSS	CAM Super Mod.	CAM Ace Pilot	Novak 410-MXc
36	4:02.27	Lynx II	East Coast	King R/C Cells	Novak 410-MXc
36	4:02.78	Lynx II	Twister	PTI	Tekin
36	4:05.02	Associated 10L SS	Reedy	Reedy	Novak
36	4:05.63	Lynx II	Trinity	Trinity	Novak
35	4:00.25	Bolink Narrow LTO	CAM	Team Smooth	Novak 410-MXc
35	4:02.68	Bolink LTO Narrow	CAM	Team Smooth	Tekin 420
34	4:06.84	Bolink LTO	CAM	Holeshot Technology	Tekin
1	0:12.04	H105E Hyperdrive	CAM	Team Smooth	Novak



beautifully and established themselves as the racers to beat. Clausen ended up on top with a flawless 45-lap run, with Doseck in 2nd and Bob Hall in 3rd. It was clear that this would be a spectacular main event.

The $1/10$ -Scale Modifieds were just as exciting. Again, Doseck drove flawlessly, and he not only qualified on top, but he did so with the fastest run of the weekend! Behind Doseck were Terry Rott in 2nd and Chris Smith in 3rd

CONCOURS

Some of the most outstanding paint jobs I've ever seen were showcased in the Concours Event. Two rows of cars lined up on the track for the judges to study and rate in two categories—Best Paint and Concours. After the judges had scrutinized each car, the victors were awarded their trophies. Jeff Yost won the Best Paint category with his beautifully painted Dr. Seltzer Lumina, and Tony Davis's Rusty Wallace Miller Genuine Draft won 1st place in Concours.

THE MAINS

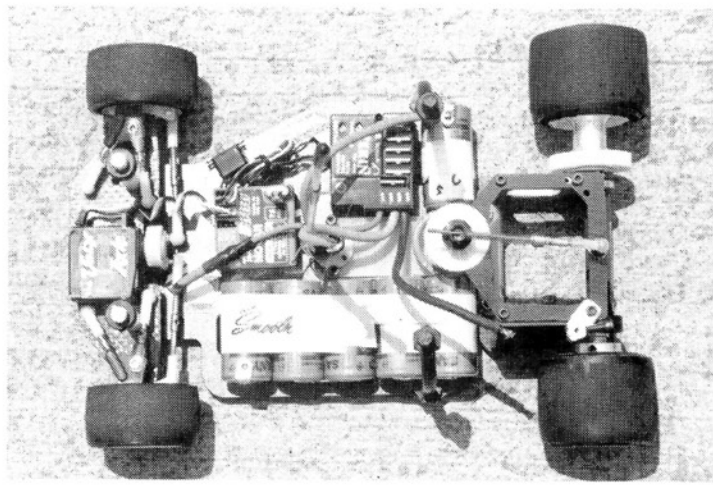
● **$1/12$ -Scale Stock Class.** This class got the races rolling. Top Qualifier Putnam worked his way through early traffic and headed for the lead. He was pursued by Sykes during the entire race, but despite the slower traffic ahead of him, Putnam held on to the lead till the end. Sykes and Hoyte Stacey followed closely behind for the 2nd- and 3rd-place finishes.

● **$1/10$ -Scale Stock Class.** Things didn't go as smoothly in this race. Top Qualifier Murphy encountered trouble very early, and he was knocked into 4th place. This put 2nd-place qualifier Poole up front, followed by Brian Painter. That's when things started to happen! Murphy got back on track and began his attack for the lead. He worked his way back to 2nd, and then back to 1st when Poole's car spun out in the final seconds. Poole finished in 2nd with Tim Holland in 3rd.

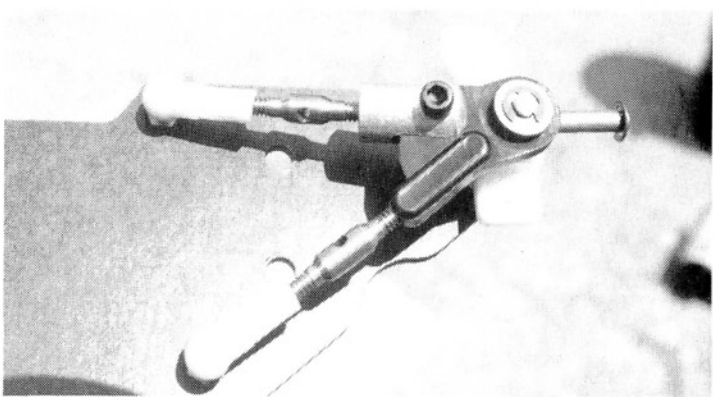
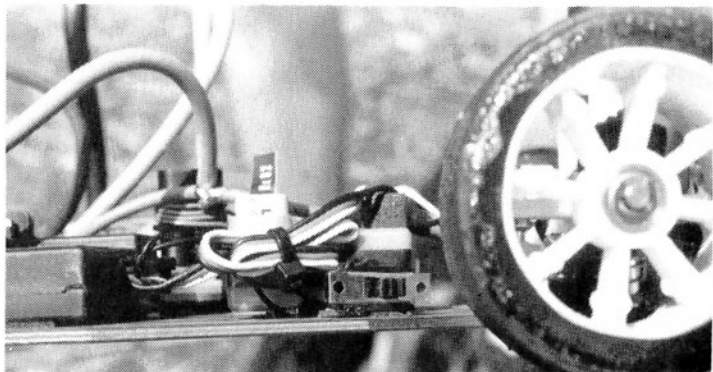
● **$1/12$ -Scale Modified**—the race that everyone had been waiting for! We'd seen the flawless driving of Doseck and Clausen, but we couldn't tell who'd be victorious. As expected, Clausen and Doseck both headed for the lead

in a blur of color. Clausen took it, with Doseck following close behind—and do I mean close! For most of the race, the two weren't more than a leap apart. Once in a while, they'd be exceptionally close, and the crowd would get all riled up. With less than a minute remaining, Clausen's car began to slow down; Doseck made his move and took the lead for the duration. As the clock ticked away, Warren Darby also passed Clausen and took 2nd. In the end, it was Doseck, Darby and Clausen.

● **$1/10$ -Scale Modified.** Doseck was now the $1/12$ -Scale World Champion and National Paved Oval Champ. Could he win the $1/10$ -Scale title, too? After dominating the qualifying rounds, he



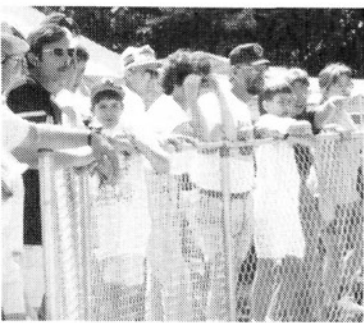
Above: Bill Rockenstyre's $1/12$ L featured a custom-made DA Graphite chassis. Below: If you look closely, you'll see its wooden core, which starts just behind the front wheels.



Many cars used the "Ugly Axle" at this event. You can bolt the unit directly onto your $1/10$ - or $1/12$ -scale chassis, and it features adjustable caster and camber.

seemed a sure thing. Doseck took the early lead ahead of 3rd-place qualifier Smith and Andy Dobson. Rott made his way past Dobson for the 3rd spot. Then, at the halfway mark, the door slammed on Doseck as his car began to slow down. Smith was in the lead, and Rott was in a good position to make a move, but he didn't. With less than a minute remaining, Smith's car spun out. This left the door open for Rott, and he made his bid for the lead. In the end, it was Rott followed by Doseck and Smith.

Th 1991 ROAR Paved Oval Nationals offered some great racing. Thanks go to PC Hobbies' Paul Covington for hosting the event as well as to all the officials who made everything run smoothly. A special thanks goes to the sponsors, TRC and Trinity, whose support made the event possible. ■



D A T E L I N N E W S

NECESSITY IS THE mother of invention, and this certainly applies to the R/C car industry. Racers and manufacturers constantly strive to improve the performance of their cars. In efforts to create the "ideal" racing machine, most competitive cars are carefully scrutinized and then modified or totally redesigned. Nowhere was this more evident than at the 1991 IFMAR World Championships in Sterling Heights, MI. With 120 of the world's most accomplished drivers in attendance, many R/C car manufacturers displayed either new hardware for existing cars or completely new cars. They were all trying to keep their competitive edge.

IFMAR '91



Masami Hirosaka of Japan was crowned the 2WD World Champion—an unprecedented fifth world title! Team Associated's Cliff Lett won the gold in the 4WD Class—his first world title!

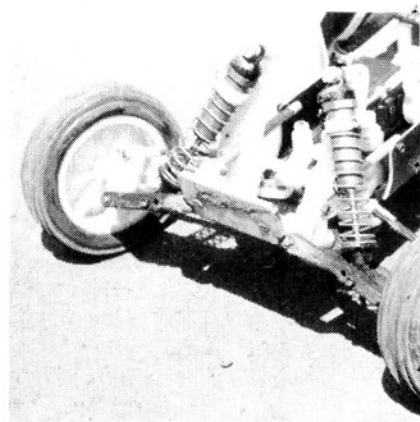
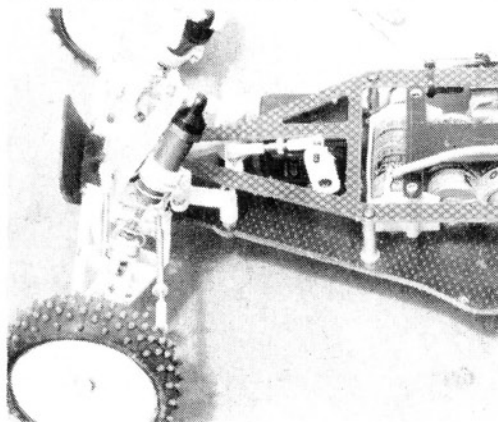
Worlds Prototypes

by STEVE POND

Right above: Here, in all its glory, is Associated's new Stealth car! It features a very rigid, double-deck graphite chassis, narrow rear-suspension mounts with long rear A-arms and a radically new front end.

Right: The Stealth's extra-long front A-arms are "swept" forward to prevent the chassis from digging-in if the car nose-dives after a jump. A narrow front bulkhead accommodates the A-arms, and the shocks are mounted on the rear of the tower. The car also uses a steering bellcrank similar to that found on the RC10T.

Far right: Associated also introduced a front-end conversion for its current aluminum-tub Team Car. It features a narrow bulkhead, long A-arms and a new steering-bellcrank system.

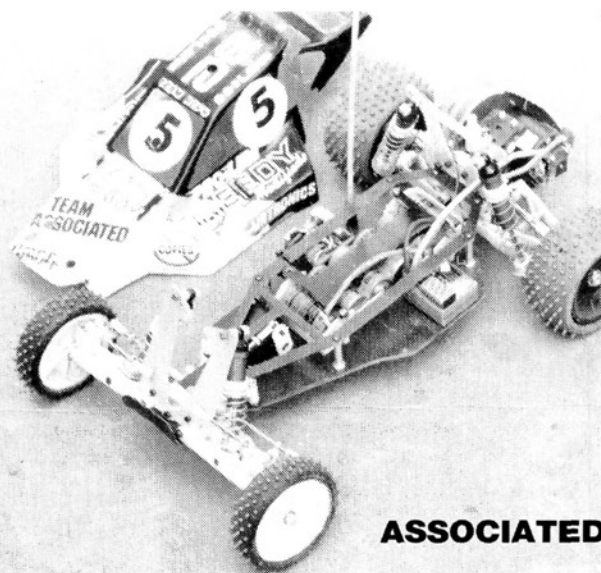


ASSOCIATED'S UPDATES

Team Associated brought two newsworthy updates: a redesigned front end for the RC10 Aluminum Team Car and the Stealth car.

The RC10's new front end features the narrow nose-plate/bulkhead assembly that's used on the recently released RC10T Stadium Truck. The car also has new suspension arms, a tall shock tower and long front shocks.

With the exception of a few parts, the long-awaited 2WD Stealth car has a completely dif-



ASSOCIATED

FLASH!

ferent design from that of the current Team Car. It features a double-deck graphite chassis (which is *extremely* rigid) and the Stealth transmission, but its suspension is radically different from anything we've ever seen.

The Stealth car's rear suspension-arm mounts are closer to its transmission, allowing the use of long suspension arms. This reduces tire scrub when the suspension is compressed. The new front end has a very narrow bulkhead that uses long arms. Both the front and the rear suspension arms have a completely new design that's light, yet strong. The car's front end is very different; many of its components are reversed from what we're used to seeing.

The Stealth car's suspension arms are "swept" forward, its shock tower is mounted toward the front of the bulkhead, and its shocks are mounted behind the tower instead of in front of it. This setup prevents the chassis from digging into the ground when the car lands nose-down after a jump, and this prevents the car from flipping. This design offers other benefits that I'm not at liberty to discuss, but rest assured, this

isn't the last you'll hear from me about this car.

"WORKS" WITH THE WORKS?

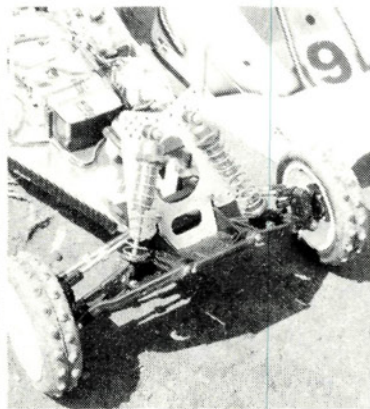
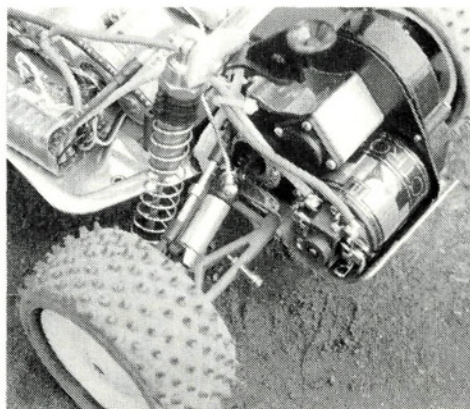
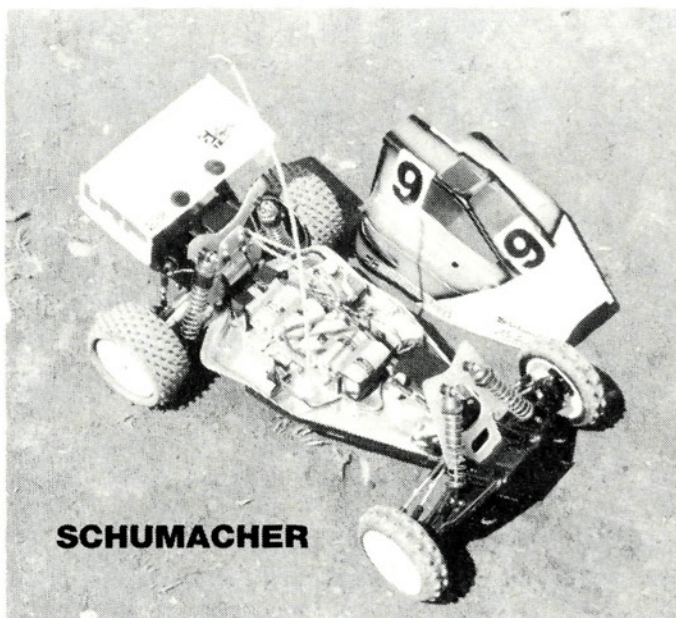
Yokomo showed up with an updated version of the 4WD Works '91 car. It features many prototype parts that are still being tested for the production version. Many of the modifications, e.g., increasing the car's suspension travel through the use of long suspension arms, were designed to tame large bumps and make the car more stable. The rear arms are swept forward to meet the long rear shocks, which are mounted on a very tall rear shock tower and are almost completely vertical. To accommodate the long front arms, the car's front end has four custom-made narrow bulkheads.

LOSI DEVELOPMENTS

Team Losi came to the Worlds with a new car that has yet to be named. Scheduled for production, it features a molded-composite chassis resembling that used on the Junior Two. An upper plate supports a new, "hinged" front end. This enables you to use either a long or a short upper plate and, thus, to change the degree of kick-up. Prototype front-suspension arms appear to improve the car's steering on high-bite tracks.

The redesigned caster blocks and steering blocks on the ends of the suspension arms also help to improve the car's steering. The steering blocks have a "floating" axle instead of one that's fixed, i.e., it rides on bearings that are in the steering block. This setup greatly reduces the amount of wheel play that can result from loose bearings, and it helps to keep the bearings clean, so they'll last longer.

Although the car's transmission is the same as those used in previous Team Losi cars, it has an entirely new slipper clutch. Referred to as a "power-on-demand" slipper by its designer, Gil Losi Jr., this unit is supposed to extend run times. The large portion of the patented "fluid" slipper clutch makes the power delivery at high speeds smooth. A second, mechanical slipper regulates power at the starting line and through tight corners.



Left above: Cecil Schumacher came to the Worlds "loaded for bear"! Here's one of his 2WD Cougars with such prototype equipment as an improved rear bulkhead, new rear A-arms molded of an undisclosed, but strong, material, and new front-suspension geometry.

Left: To improve its stability on rough tracks, the Cougar prototype's front end has new A-arms and a tall shock tower that's designed to work with long shocks.

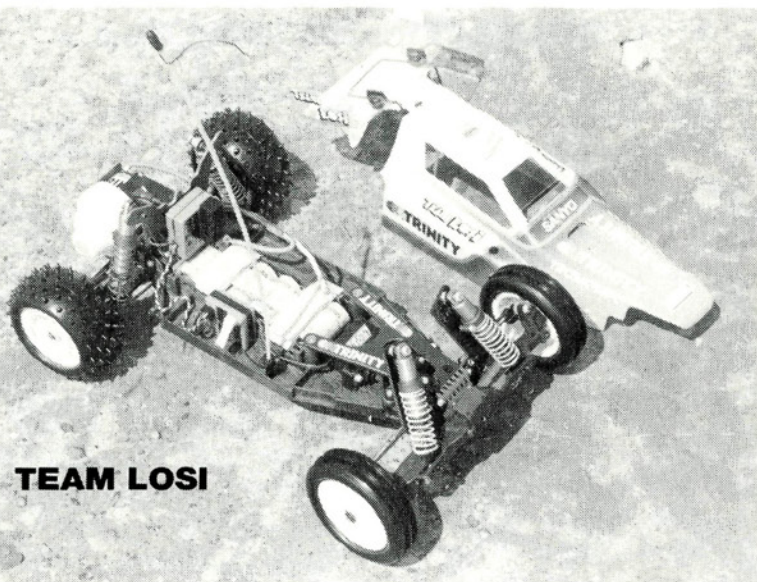
Far left: In the rear, Schumacher experimented with new aluminum universal-joint/slider shafts. The standard Cougar transmission was used, but it had a slipper clutch and an aluminum housing.

PHOTOS BY STEVE POND

IFMAR '91 Worlds Prototypes



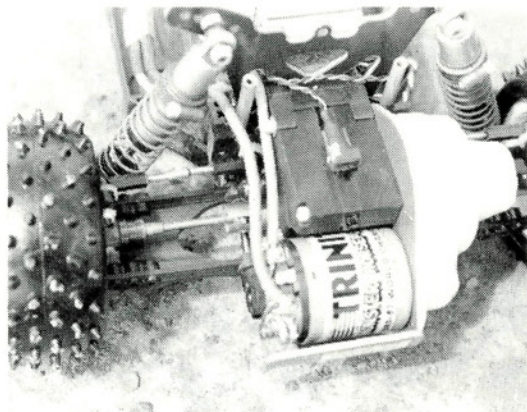
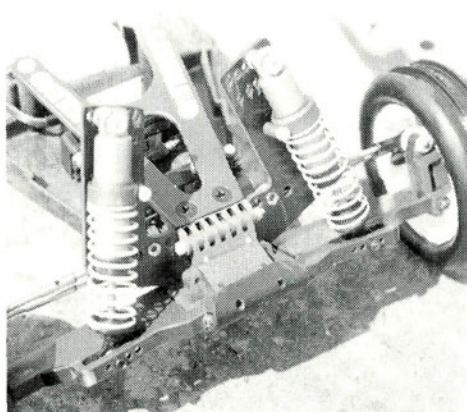
TEAM LOSI



Above right: Team Losi campaigned with an un-named prototype car—Kyle Reed called it the "Double X."

Right: The Losi prototype had a narrow front bulkhead that allowed the rake angle to be adjusted and an experimental front A-arm that was designed to improve steering.

Far right: The rear of the Losi car featured a new MIP universal driveshaft. The large white gear cover conceals Losi's top-secret, two-stage, "fluid" slipper clutch.



Many of the Losi cars at the Worlds also used MIP's universal-joint dogbones. Although they're still being tested, they seem to have less friction under load. Gil Losi Sr. commented, "There are some tracks where the dogbones work better; there are some where the sliders work better. It's hard to say what we're going to go with." Losi cars also featured steering bellcranks that enabled the drivers to adjust the Ackerman effect by changing the location of the center link that connects the two bellcranks.

KYOSHO MOTION

Kyosho drivers campaigned with the new Triumph 2WD car and the 4WD Lazer ZXR. Although the Triumph was introduced prior to the Worlds, it featured a few race-made parts, i.e., a diff, shock towers and suspension components that were molded of a strong material to withstand the rigors of world competition.

Although it's similar to the Lazer ZX, the ZXR has more competition-oriented parts. Its new graphite chassis was designed to be used with 6-cell packs (the maximum number allowed under IFMAR rules). The cells are positioned more toward the car's rear, and this improves rear bite and stabilizes the car during jumps. Ball diffs (slated to be included in the production kit)

are used in the front and the rear. Both the 2WD and 4WD cars use new shocks with Teflon-coated bodies. The shocks' caps have holes in them to prevent air pressure from building up behind the pressure gaskets inside the shocks.

SCHUMACHER STUFF

Although some Schumacher cars ran with production equipment, many had impressive new goodies. The 2WD Cougar features long front shocks and a new front shock tower that makes the shocks' damping action more progressive. The new rear shock towers have more shock-mounting locations, and new, slider-style drive shafts drive the wheels. (They're supposed to operate much more efficiently than earlier sliders.)

PRODUCTION PROLOGUES?

Keep in mind that many of the items mentioned here are prototypes. Some are very close to production; some aren't. Some might never make it to the hobby-shop shelves! Races like the World Championships are excellent places to test parts before production. The mods and upgrades that work at this event may be used on production cars, and those that don't work, won't. ■

Car Action Interview:

CLIFF

by FRANK MASI

Frank: Start by telling us a little about how you first got started in R/C? What was your first car?

Cliff: My first car was an Associated RC12E on-road car. I was working for Yamaha at the time. I wasn't a mechanic; I was working in what they call their "race-support department"...with a lot of amateur riders and semi-pro riders. I bought the 12E because, a lot of times, we'd go to the races and have nothing to do. At a hotel parking lot, everybody'd take turns driving my 12E; so, basically, it was just a parking-lot car to play around with. I had a box radio for it. It was really a heap!

Well anyway, it had a short life because one of the riders—Johnny O'Mara—drove it underneath a car that was driving through the parking lot and, as you can guess, it became a pancake. That was the end of my 12E.

FM: But, obviously, that

wasn't the end of your interest in R/C.

CL: Well, a while after the 12E disaster, around November '84, I was on a business trip and saw my first off-road race. I saw a whole parking lot full of cars and what looked like rats running around a dirt track. I got out of the car and watched these guys drive around the track. It looked like so much fun. Later that evening, I went down to Hobby Shack and bought a Cox Tomahawk because they didn't have Scorpions. Everyone was racing Scorpions.

FM: Was that the beginning of your off-road racing career?

CL: Kind of. I drove the Tomahawk for a couple of weeks, just playing around. I did race it once—I think it was an oval race—and I got kind of lucky and actually won the stock class; and I had never raced before! Needless to say, I was hooked on racing. Then I heard this rumor about a car called the RC10, and I was really interested. A month later, the RC10 was re-

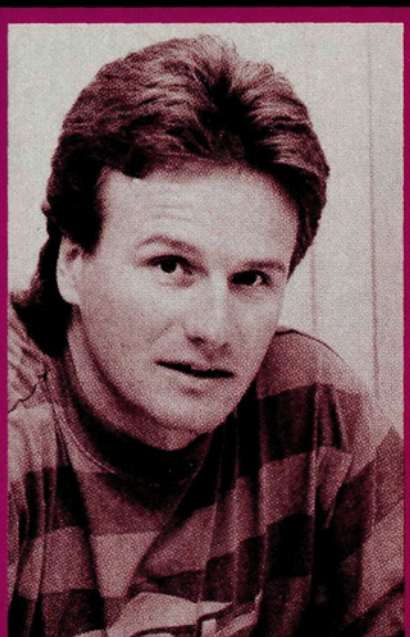
leased, and I bought two. That was December '84, and I was totally hooked. I met Jay Halsey in '85, and he and his dad got me rolling and showed me what the hot setups were.

FM: Did you begin to race a lot then?

CL: It was very difficult for me to race because my job as a Yamaha factory mechanic required me to work almost every weekend; and, usually, Thursday, Friday and Monday were pretty well shot also. The rest of the time I spent in the office, so my racing was sporadic—once every couple of months until 1986, when I left the racing department...and moved into a position in re-



PHOTOS BY GENE HUSTING



LEFT

CLIFF NOTES



search and development. That was an 8- to-5, five-day work week, so I had weekends off.

I left Yamaha in April '88 and started work here at Associated, and that's when I really started racing a couple of times a week, every week; and the results started to show. I won four national titles.

FM: At first, R/C racing was a hobby, but now it's your full-time job. What's that like?

CL: You have to keep the two separated. I don't get to work on my cars on company time unless it's for testing. I work on company projects, prototype work, R&D stuff. By the time you're done with your work, looking at cars all day long, you're ready to go home and relax or watch TV, not pick up a car and start rebuilding it for another three or four hours.

FM: You sound like a busy guy. How do you find time to race?

CL: Between work and school, I can only race about every couple of weeks, so I try to go to as many large races as I can. Once you've done reasonably well at a large race, it's easy to look forward to the next race, especially if it's a different scale. And I think that's the key to my interest in the hobby (as well as it being a job): I drive all different scales.

FM: In which scales do you drive, and which is your favorite?

CL: Driving $1/8$ scale is really exciting because it's noisy and it's fast, and the races are longer, and there's a pit crew involved. That's a whole

different atmosphere. Then there's $1/10$ -scale on-road, which is a very serious type of racing; everybody's fast, and batteries and motors are critical. Off-road is a completely different type of setup also. You have to negotiate jumps and actually control the car's attitude while it's in the air, sliding it so you're

not completely glued to the ground. It's a different feeling: driving an off-road car not an on-road car. With an on-road car, you actually have to get used to driving a perfect line because the car doesn't slide. Each scale takes a different driving style; different setups.

FM: How do you manage to keep your interest high and not get "burned out"?

CL: Junior [Losi] has asked me the same question several times.... Well, it's a very hard thing to do, but I think you have to have a competitive spirit...I have to be competitive or I won't do it. It's getting tougher and tougher because the racers are getting faster and faster. These younger guys coming up have faster reaction times. They're learning a lot from us older guys; and...the cars are a lot better, so they have to do less and less on their cars to be competitive. And me, I'm a person here with a job—my own company (RCPS); I'm trying to race and be competitive; I'm trying to go to school; and they have no responsibilities in life, except to sleep, eat and race.

FM: Would you care to name names?

CL: As soon as they read this, they'll all know who they are. I'm not insulting them in any way; I'm complimenting them. They're young and they're talented. They're in a sport that will keep them out of trouble and off the street; and it will teach them sportsmanship, a competitive spirit and a lot of mechanics, which is really important.

FM: What's your job title at Associated, and what are your main responsibilities?

CL: Research and Development Manager. Roger [Curtis], Curtis [Husting] and I work together on new concepts and new ideas and goals. I can't say that any one of us comes up with all the designs. If one of us has an idea, the other two's input usually improves it. From there, it goes into a sketch that either Curtis or I will be responsible for; and then it goes into the prototype part, which Curtis does. It's very easy to design something so that it can be machined; but designing a part so that it can be molded is a whole other can of worms!

FM: What's your latest project at Associated?

CL: Obviously, we've just finished the truck. I just got back from the $1/8$ -Scale Worlds, which was in Austin, TX. While we were there, we had a partially assembled truck in our hotel room. (Some of the drivers were trying to break into my room so that they could have one for themselves.) We'd been working on getting suspension components and parts ready to go racing in the World Championships; and we're just two weeks away; and we're just kind of finalizing all those parts and getting ready to go. I feel really good about going to the off-road World Championships; in fact, I feel better about going to this one than I did going to Australia.

FM: Why is that?

CL: Well, I just think we'll be more competitive here than we were in Australia. I think we're better prepared, and we have a better goal and a better plan. Australia was kind of a last-minute effort on our part, and I totally, physically drained myself prior to going there. I realized it was the best thing to do for the company and for the team to do as well as they did, but it took a lot out of my performance. And I think this time, we're far enough ahead to where I'll have time to go out and practice be-

fore we leave and actually be ready myself, besides being ready team-wise.

FM: *I'm sure no one in the industry is more aware than you of the "Stealth car mania." Is this what you'll be running at the Worlds this year?*

CL: We're taking a so-called "Stealth" car with us—not the same car we ran in Australia. The car in Australia I think was very overrated. I was very, very hesitant as to whether we should even take the car to Australia because in our testing, I wasn't totally pleased with it myself, as a driver. I thought we needed more time and that we still needed to change parts of the car, but we ran out of time, and we had to go. We basically finished the car while we were in Australia. We took fiberglass and parts with us, and we actually used Dremels to cut out a lot of the parts we used on the cars; and we made changes while we were there. We were lucky enough to have a week of practice. In my opinion, the Stealth car there was a very, very mild variation on the RC10. Yes, it had a graphite chassis, and yes, it used a basic standard rear end with a new transmission, which is out now. It's the same transmission, only it was in the prototype form. The front end uses extremely long suspension arms and a different progression as far as the shocks and the suspension arms are concerned. In addition to the "Stealth" car, we'll be taking some different suspension components to use on standard RC10s. We don't know what's going to work until we get there.

FM: *When you arrive at a new track, what's your method of practicing? What works best for you?*

CL: The first thing I like to do, especially if it's a major event, is have Gene or somebody we know videotape the race. I have a big-screen TV at home. I'll watch the videotape 20, 30 times, just watching the track. That way, when you show up, you feel like you've been there before. So when you're in the drivers' stand, you already have timing points on

the track. It's all timing; R/C car driving is just a game of timing.

When I arrive at the track, usually, the first thing I do is I walk right up on the drivers' stand and I stand there, and I just kind of look over things a little bit; stand there for a while; watch some drivers drive around the track; and I'd just about guarantee that if anybody did that, they could put their car on the track the first time and actually look 50-percent dialed from that point.

FM: *Is there any particular area of the track that you concentrate on for initial set-up? Moguls? A particularly hairy jump or something like that?—a difficult section.*

CL: The two obstacles that you referred to; it depends on where they are. Obviously, if you have a set of moguls before a straightaway, it's very critical to get through them as quickly as possible to have more momentum going when you get on the straight. I tend to have a reputation for suspension and getting my car to work smoothly and, for that reason, I usually concentrate on rougher areas of the track. I prefer a track that's rougher because it requires a lot more line driving. If I can get a small advantage on one part of the track, that means I don't have to go as fast on another part of it. Jumps are also easy places to make up time. They all require a different setup; a slightly different driving style. It's one thing to be able to go superfast in a rough section, but if you can only do it three out of five times, you won't go very fast. If you could do it moderately fast, but you could do it five out of five times, day in and day out, you'll win; there's no doubt about it.

FM: *What's your technique for making a good start?*

CL: Well, obviously, you want to be on the front row! [laughs]. That's the best place to start sometimes. Sometimes, it's better to be on the back row. I would have liked to have been in the back row in Michigan at the Worlds' Warmup. I think that getting off the line quickly and actually con-

centrating on when they're going to give you the time signal to start the race is important. If you can just totally block out everything around you, every sound around you, and forget you're at a major race and just concentrate on the very next sound you hear, you can have good fast reaction time to get off the line quick.

FM: *You seem to have a reputation for being one of the smoothest drivers around. Is this something you work hard at, or does it just come naturally?*

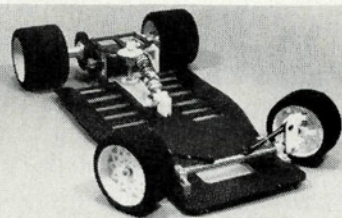
CL: I think it has a lot to do with being relaxed and the way I set the car up. Rather than being the fastest person on the track or having the very fastest car, it's really important to be fast the entire time and yet have the car easy to drive at that speed. To go the fastest, you have to drive on the ragged edge; and to drive on the ragged edge, you have to take chances. So my theory is a g-o-o-d moderately fast speed; but be able to do it lap after lap without even thinking about it. It's just automatic.

FM: *Are you ever nervous before a race—especially a big one?*

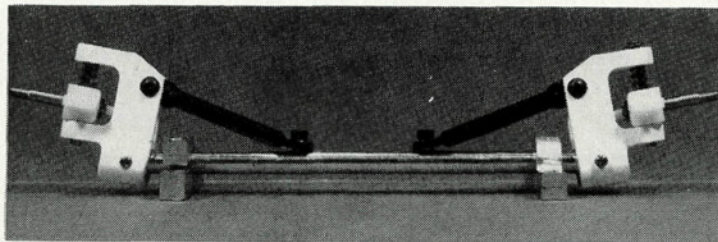
CL: Yeh; I think everybody gets nervous. I don't care what anybody tells you. If they tell you they're not, they're lying. Some people show it differently. I start thinking about different parts of the race and try to get my mind off the start and the outcome of the race. I think that now, since a lot of the big races are so important to the drivers and to the manufacturers, there's a lot more pressure on everybody. Everybody wants to win. You really have to go to these races with that kind of attitude. If you don't win, that's fine, too. There's another race down the road.

FM: *I'm sure you've heard people say that the factory drivers have it made: they get free stuff; they get to travel all over the world. Would you care to shed some light on this?*

CL: OK. When you go to a big race in another country, you have to plan

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Interview:

months in advance, and usually, it's always when you're busiest. You fly into a place, you get a rent-a-car, you drive to the hotel, you unpack all your stuff. Well, you've seen *some* countryside traveling from the airport to the hotel. Practice usually starts the next morning, so you spend all day at the track and practice. Racing never goes on schedule, so you end up staying in the evening—working on your cars. By then it's one or two in the morning; you get some sleep—four or five hours. You get up, you go back to the track and start qualifying. And by the time the races are over on Sunday, you're totally physically drained. You get up in the morning, and you go home. So, really, travel around the world isn't all it's cracked up to be or what some people think it is. Yeh, it's great; I'd never pass it up for anything. There are certain types of racing, like off-road, in which I think equipment—mainly batteries and motors—isn't very critical. In off-road, car set-up is more important. And being able to drive the car consistently and comfortably is the most important thing—and, obviously, ability. In 1/12-scale and 1/10-scale on-road, again, driving ability is very critical; and when you go into oval racing, the factory guys do have it made, because now you're entering motor/battery racing. If you don't have a motor and battery sponsor, you're in deep trouble.

FM: Last question. Where do you see yourself being five years down the line?

CL: Well, I plan to stay at Associated a long time. They've made me feel at home—like one of the family. I enjoy working with Roger. He's taught me a lot while I've been here. He's allowed me to go to school while I've worked here and, you know, I'm not sure where this industry will go at this point, but it seems to be going very well at Associated. I plan to continue my education, because I see it as a way of investing in myself. Eventually, I'll have to slow down, and when I do that, I'd like to get more involved in the racing organizations and see that they progress in a positive manner. (I'm trying to say a nice neutral word there!) So, as long as I'm learning and benefitting my job and what I do, it's worthwhile.

FM: Thanks for taking the time out of your busy schedule for this interview. I'm sure all our readers will appreciate it.

CL: You're welcome.

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PROJECT

QUICK! NAME A state-of-the-art, 4WD, off-road car that's capable of making the A-Mains at any race. Chances are, many of you said "Kyosho Lazer"—not surprising—but I bet there's something that you don't know: there are important differences between the car that comes out of the colorful Kyosho* box and the car that the pros use. By no means am I putting down all the box-stock Lazers out there, but if you *really* want to go fast with your Lazer, certain parts should never be taken out of the box.

"Project Lazer" isn't intended to be about how much money you can spend on a car—a rolling catalogue of after-market parts—but rather as an informative project that will let those who already own or are planning to buy Kyosho's 4WD flagship know how the Lazer should be modified for competition, and why.

I've divided this article into sections, each describing a particular modification. I start with the modifications that I think are absolutely essential, and end with changes that I made because of personal preferences. They may or may not be to *your* liking!

PHOTOS BY STEVE POND



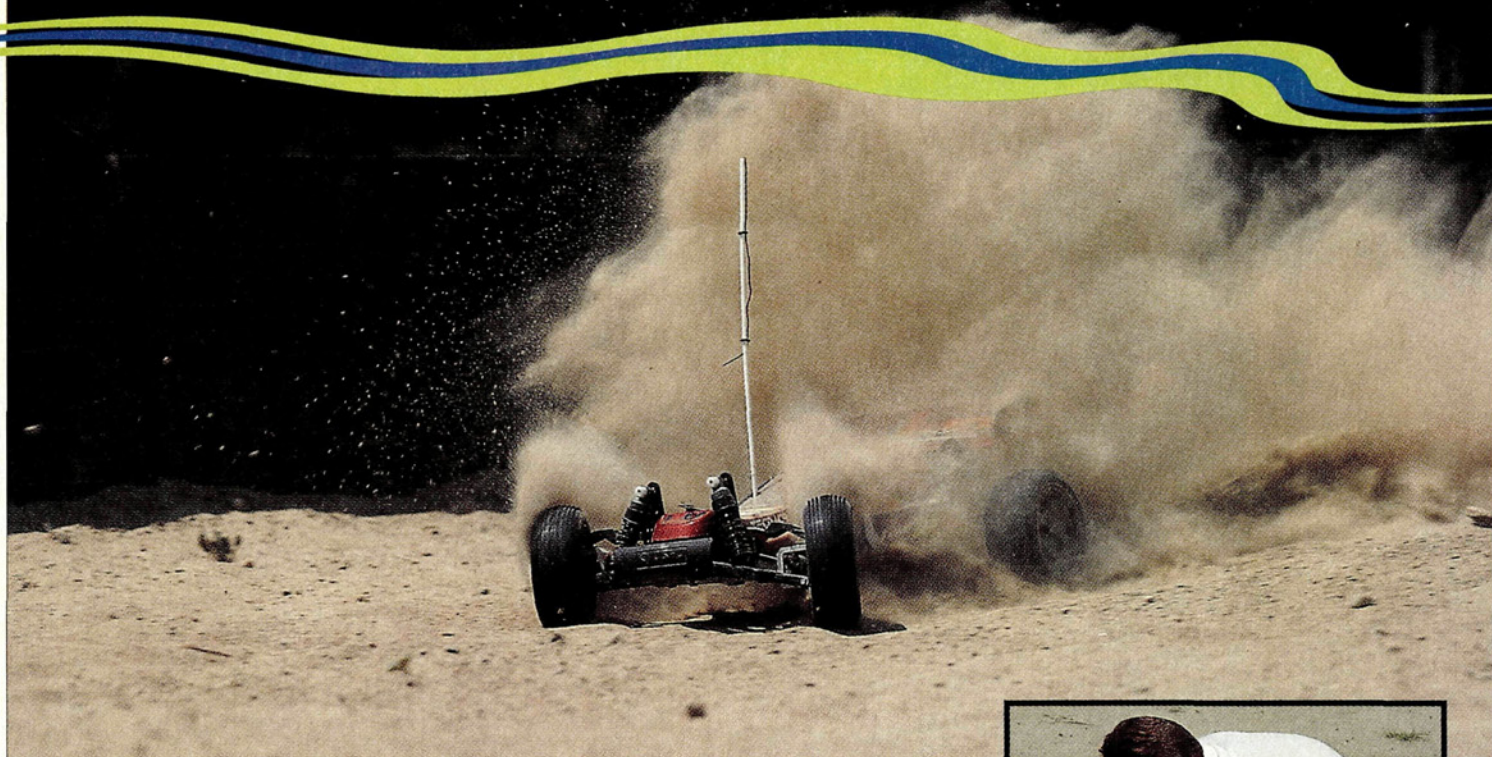
LAZER

Radio Control
Racer



Four-Wheel inferno

by FRANK MASI



DRIVE-LINE ENHANCEMENT

Without a doubt, the gear differentials (diffs) should never be taken out of their blister packages. The reason for this is very simple. A car that's equipped with gear diffs tends to waste a lot of precious horsepower spinning its wheels unnecessarily. If the inside wheel of a cornering car (with gear diffs) leaves the track (a constant occurrence in off-road), the wheel that re-

mains on the ground will lose its drive until the other comes back down—not very efficient!

Buy ball diffs when you buy your Lazer. *This is the single most important modification!* All Kyosho ball diffs use the same components. The only variation is in the diff pulleys, but don't worry; the correct pulleys for the Lazer are included in the kit. Any Kyosho ball diff (Ultima, Optima Mid, etc.)

will work well.

Kyosho recently upgraded its ball diffs. The new design, which is standard equipment on the new Triumph 2WD car, features separate drive rings for the diff plates (previously a one-piece design). I've taken this idea a little further, however, and installed MK Engineering's* Pro Diff Kits for the Kyosho ball diffs. These have the same basic design as the new Kyosho units, but the MK parts use Associated Electric's* Stealth diff rings, which are more widely available than the Kyosho rings. Additionally, the MK plates are made of light 2024 aluminum (the Kyosho plates are of heavier steel), and they have a "no-slip" design that eliminates the need to pin or glue the diff rings into place.



GIVEN THE SHAFT!

The next modification is another essential (in my book, anyway). The basic idea behind the center diff is good, but it's much more effective (and needed) on the larger, more powerful 1/8-scale gas off-road cars for which it was originally designed.

This is how the center diff/torque splitter works: the drive hub to the rear wheels rides on the main center shaft by means of a one-way bearing. This hub constitutes the inner part of the center diff. Also on this main shaft is another hub that rides on a one-way bearing, and this hub is for the front wheels. The drive

K O L O R
T R A N S P A R E N C Y



THE RC10 was introduced in 1984, and today, its basic configuration remains intact. The Losi JR-X2 hit the scene in 1987, and despite its refinements, it's the same car in 1991. Four-wheel-drive cars, however, seem to go through major design changes about every two years, and Kyosho's line of competition 4WD cars is no exception.

The first Kyosho 4WD car that made an impact on the R/C racing community was the chain-driven Optima, which had front and rear differentials, 4W independent suspension and long A-arms on all corners. The Optima's unique, aluminum-"bar" chassis and composite upper chassis plate were very rigid.

Kyosho didn't rest on the Optima's laurels; it soon came out with an improved version called the "Turbo Optima," which used (among other things) Kyosho's now-famous Gold shocks. Back in '85, the Optima and the then-world champion Yokomo Dogfighter were the cars to beat.

Eventually, Kyosho decided that the Optima's rear-motor design wasn't the way to go with a 4WD car, and at the 1987 IFMAR World Championships in Romsey,

England, they unveiled a prototype mid-engine car—the Optima Mid—five of which made it into the A-Main.

The people at Kyosho also thought that a Kevlar-reinforced belt would transfer drive power more efficiently than the older Optima's chain. Kyosho soon introduced the Optima Mid SE, which had ball differentials, full ball bearings, universal-joint drive shafts up front, and Kyosho's Platinum shocks. The Optima Mid SE was truly an out-of-the-box winner, and it found its way into the hands of many racers throughout the world.

After-market manufacturers soon "flooded" consumers with goodies for the Optima and Optima Mid Series. On-road conversions, truck conversions, and even trailing-arm and long-wheelbase chassis kits could be found at any well-stocked hobby shop.

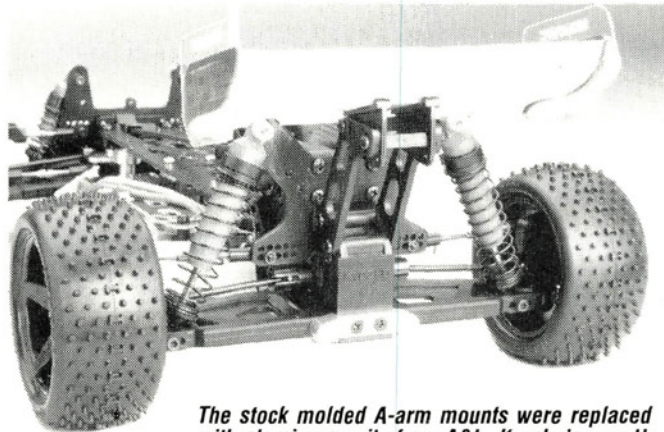
If Kyosho's new Lazer is a little too high-tech for you, there are still some Optimas and Optima Mids to be found if you look hard enough.



OPTIMUM OVERDRIVE!

hubs are connected and driven by the spur gear, which incorporates diff balls that enable the hubs to operate as "halves" of a standard diff. Here's the problem: the rear wheels lose all drive when the front wheels leave the ground, then abruptly regain it when the fronts come back down. This not only wastes a lot of power, but it can also significantly slow the car. There are two solutions to this dilemma; one costs a little money, the other is free.

The simplest (and cheapest) way to rectify the situation is to remove the diff balls from the spur gear, and then lock the assembly



The stock molded A-arm mounts were replaced with aluminum units from A&L. Kyosho's new H-pattern tires provide awesome traction. The front and rear shocks have been hard-anodized.

down by tightening the center diff adjustment nut as far as you can. Now the center diff is no longer functional, and your Lazer has constant rear-wheel drive, yet your

front wheels can still free-wheel on the front drive hub's one-way bearing. I've raced a Lazer in this configuration for more than one season, and I've found

that this setup vastly increases the car's acceleration and response.

For the Lazer, I decided to try the new Peak Performance* one-piece center shaft. This piece replaces the heavier main shaft and rear-drive hub assembly with an integral hub and shaft. Additionally, the front-drive hub with its one-way bearing works perfectly with this new shaft. Besides being lighter, the Peak Performance shaft allows you to use any after-market spur gear—well, almost any.

Just before I started this project, Du-Mor* R/C sent me samples of its new line of beveled "Star Force"

spur gears, and I thought that the 48-pitch, 96-tooth gear would be perfect for the Lazer. Unfortunately, about the only gear hole pattern that didn't fit on the Peak Performance shaft was—you guessed it!—the Du-Mor. I was determined, however, to use this gear, and it was fairly simple to drill and tap an additional set of holes in the shaft for it. Now my top shaft really does fit *any* spur gear!

UNIVERSAL APPEAL

On to the last of the Lazer's "must-have" modifications! In stock form, the Lazer has universal-joint drive shafts on the front, but it has traditional (and, in my opinion, outdated) dogbones on the rear. If you buy another set of front universals to use in the rear, you'll quickly notice that they're a little too short. The old solution was to run the back of the car with a little less suspension travel to prevent the drive shafts from falling out. Not any more! Kyosho has just introduced universal-joint drive shafts that are specifically designed for the rear of the Lazer, and the new shafts are approximately 3mm longer. Naturally, I had to use a set on Project Lazer.



PLATE TECTONICS

The stock Lazer uses a two-piece carbon-fiber top plate

to keep the chassis as rigid as possible. This arrangement works well, but some torsional (side to

side) flexing still occurs. To remedy this, I used an HPI* one-piece graphite top plate. This high-quality part is actually slightly lighter than the two stock pieces, and it really limits flexing in *all* directions.

A&LUMINUM!

Coincidentally (honest!), A&L Mfg.* released a multitude of high-quality aluminum replacement parts for the Lazer at just about the same time I started to work on the car. Of course, I had to test these pieces thoroughly! First, I replaced the stock aluminum motor-mounting plate with A&L's one-piece finned plate. With this plate, you don't need the second, small, aluminum motor-mounting piece that must be used with the stock plate. The A&L finned plate also dissipates the motor's heat more efficiently than the stock plate does.

Next, I replaced all the molded suspension-arm mounts with aluminum ones from A&L. Besides looking terrific, these pieces can definitely handle more abuse than the stock ones, and the slight

P A R T S U S E D

A&L

- Aluminum rear bulkhead 3809 \$ 24.95
- Aluminum front bulkhead 3808 \$ 19.95
- Aluminum caster blocks w/bearings 3801 \$ 49.95
- Front aluminum suspension mounts 3802 \$ 19.95
- Rear aluminum suspension mounts 3804 \$ 19.95
- Aluminum heat-sink motor plate 3806 \$ 21.50
- Aluminum steering bellcranks w/bearings 3807 \$ 49.95

DU-MOR R/C

- Star Force 48-pitch spur gear STAR-96 T \$5.75

HPI

- Super Star 2.2-inch rims (f/r) 2505/2555 \$ 6/pair
- One-piece radio tray (graphite) 6045 \$ 19
- Uno modified motor (14-turn double) 1060 \$ 65

KYOSHO

- Universal swing shaft 3L W-5063 \$ 29.90
- H-pattern 2.2-inch tires (rear) W-72040 \$ 10.95
- H-pattern 2.2-inch tires (front) W-72047 \$ 10.95
- Molded hub carriers OT-016 \$ 7.99

MK ENGINEERING

- Kyosho diff upgrade MC-2010 \$16.95

RPM

- Spring collars 7022 \$ 5.95

TECHNACRAFT

- Titanium tie-rod kit 11-06L \$ 21.95

PEAK PERFORMANCE

- Top Layshaft PP-3000 \$ 30.00

weight gain is negligible when compared with the extra strength of the aluminum mounts.

A few final words about the suspension-arm mounts: I noticed that the front pair of A&L mounts is beveled and drilled to match the caster angle of the front arms perfectly. But if you own a Lazer, you'll know that, on the front diff housing, it has two sets of mounting holes that enable you to vary caster angle. The A&L mounts, however, can only be used in the lower set of holes, so the car has to be run with less caster. So, for bumpy tracks on which I want the front arms to pivot at a greater angle to the track's surface, I might switch back to the stock mounts up front.

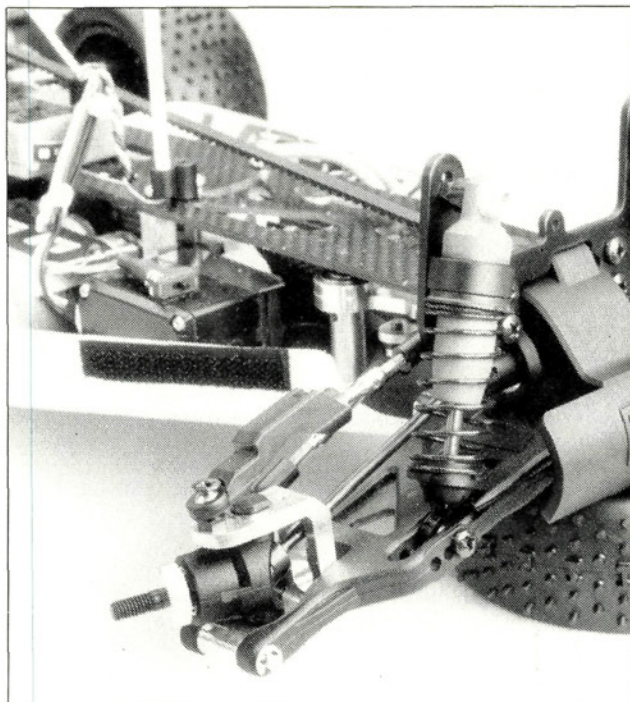
Although the stock steering on the Lazer works well, I couldn't resist trying the A&L ball-bearing steering kit. This kit consists of two aluminum posts, a set of aluminum steering arms, and four $1/4 \times 3/8$ -inch flanged bearings. Needless to say, its operation is incredibly smooth and friction-free. Another neat item from A&L is the machined-aluminum (I guess they

really like aluminum!) bulkheads that replace the Lazer's standard molded-nylon ones. When they're used with the HPI upper chassis plate, they really make for a rigid chassis.

Rounding out the list of A&L Lazer products is a pair of beautiful machined-aluminum front-steering hub carriers with integral ball bearings in which the steering hubs' kingpins pivot. I tossed the kit's cast-aluminum steering hubs in favor of molded-nylon ones from Kyosho. These hubs are substantially lighter and less likely to break than the stock hubs. I've also noticed that the nylon hubs retain the U-joint bearings better than the old aluminum ones did. This helps to keep front-wheel "slop" in check.

BUMP AND GRIND

Now we come to the modifications that don't require anything but your time and labor! You might think that no one at Kyosho had ever built a Lazer. If they had, they would have noticed that the steering throw is severely limited, because the steering hubs hit the front A-arms at almost anything *but* the straight-ahead



With the wheel off, many of the Project Lazer modifications can be seen. The stock molded hub carriers were replaced with A&L's machined-aluminum units, and the hubs themselves are of molded nylon and made by RPM. Technacraft's titanium turnbuckles are used, and the shocks have been hard-anodized.

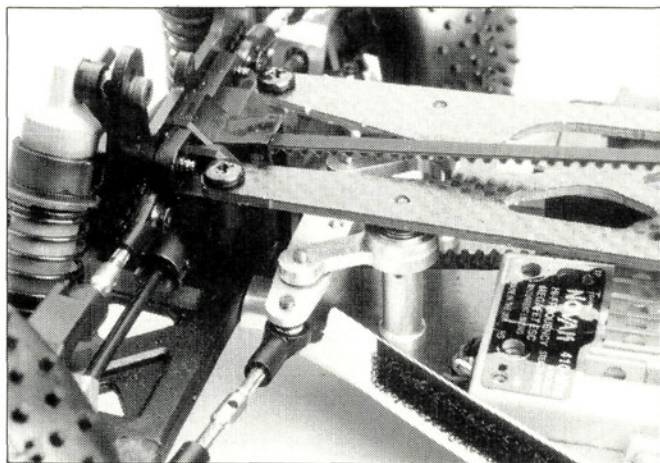
position. If you want your Lazer to turn, both front A-arms will need a substantial amount of grinding and filing to allow the steering hubs to achieve maximum travel.

The best way to accomplish this is to assemble the front suspension (following the instructions) and then *slowly* grind away the parts of the A-arms that inhibit steering movement (a Dremel tool works best for

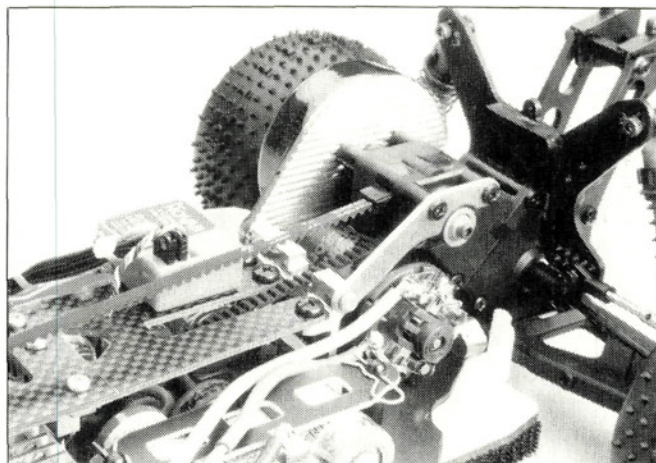
this). I emphasize the word "slowly" here because you mustn't take too much off the A-arms, or they'll be too weak to handle the stresses of off-road racing.

If you really want to get "trick," you can do what I did: remove those parts of the lower graphite chassis plate that don't increase the car's rigidity. Because the HPI graphite upper chassis plate keeps the bottom plate

(Continued on page 170)



HPI's one-piece, graphite, upper chassis plate helps to keep the car rigid, and it can be bolted onto the Lazer without modifications. In this photo, you can see the A&L aluminum bellcrank steering system.



The body and the under-tray protect against dirt and dust, so you don't have to use the kit's ladder-type belt guard. A&L's aluminum heat-sink motor-mounting plate dissipates heat more effectively than the stock one.

SPEED SHOP

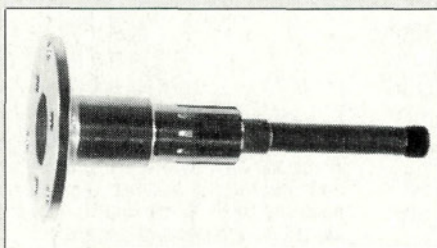
Descriptions of the products shown on these pages were derived from press releases supplied by manufacturers and/or their advertising agencies. The information given is neither an endorsement of the product by *Radio Control Car Action*, nor a guarantee of performance or safety. If you write to the manufacturer about any product described here, be sure to say that you read about it in *Radio Control Car Action*.

PEAK PERFORMANCE

• Kyosho Lazer Center Shaft—

This center drive shaft was developed and tested by Rick Hohwart and the Peak Performance Racing Team as a replacement for the center diff shaft on the Kyosho Lazer. It has one-way drive in front, but its rear is a more conventional direct-drive setup. The center diff has been replaced by a hub and an adapter that allow you to use the stock spur gear or one of the many after-market gears, e.g., Kimbrough, Du-Mor, etc. Because it's light, it increases the overall efficiency of the drive train. Rick Hohwart used it to win the 1990 ROAR Region 6 Championship and to TQ in '91 at the Florida Winter Champs.

For more information, contact Peak Performance, 1362 East Edinger, Building B, Santa Ana, CA 92705.



ASSOCIATED ELECTRICS

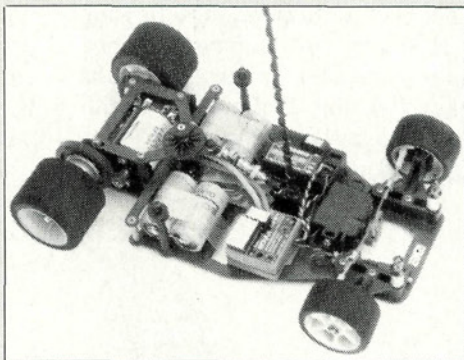
• RC12LW—

The new RC12LW was named by the Associated Team's racers. At the IFMAR World Championships in Singapore, they called it the "World's car," hence the official designation, RC12-LW. Its battery position differs from that of the RC12L. The batteries are closer to the car's center line, and this shift in weight makes steering more responsive—most apparent on a track's S-curves. To make this change, the company redesigned half of the 12L and added a shock absorber. Does it help handling? The Associated Team said it did and went on to take 1st, 2nd and 3rd, as well as Top Qualifier honors, in Singapore!

Price: \$220; \$130.

Part nos. 4406 (graphite chassis); 4405 (fiberglass chassis).

For more information, contact Associated Electrics Inc., 3585 Cadillac Ave., Costa Mesa, CA 92626.



PRO-LINE

• Narrow Front Racing Tires—

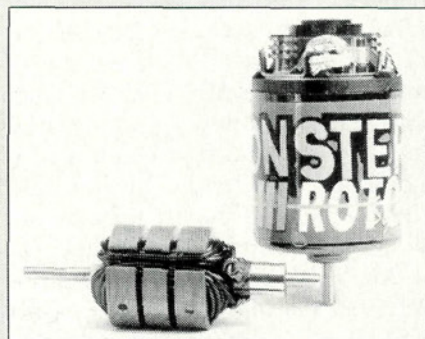
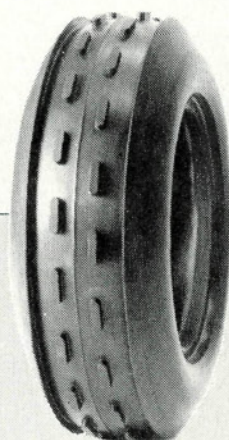
Encouraged by the success of these truck tires in the Modified Truck

Class at the Florida Winter Champs and at the Los Angeles Model and Hobby Show, Pro-Line has now made them available to enthusiasts all over the country. Use them as direct replacements for the RC10's narrow, front, truck wheel; they're patterned after the popular no. 7045 red front racing tire.

Price: \$13.95/pair

Part no. 7055

For more information, contact Pro-Line Marketing Division, 40490 RCR 186, Suite A-6, Steamboat Springs, CO 80477.



TRINITY

• Tri-Rotor Motors

Trinity's Tri-Rotor modified motors have new armatures that are designed to run more coolly and produce more power than standard ones. Their laminations are split into three sections, and this reduces their running resistance and allows cooling air to reach the center of the wire mass. The motors also have the latest 1.3mm motor cans and 4.9 wet magnets. Using a Tri-Rotor, Joel "Magic" Johnson won the 4-Cell Trinity Shootout and ran the fastest 43-lap run ever made at Lake Whippoorwill. (Armatures are available separately.)

Prices: \$80 (motors); \$35 (armatures).

For more information, contact Trinity Products Inc., 1901 E. Linden Ave., #8, Linden, NJ 07036.



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AUTOSCORE

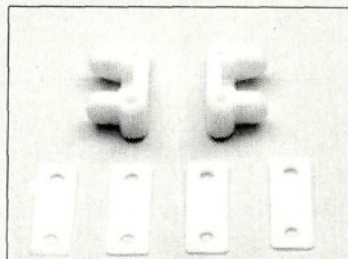
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Ventura, Ca 93001 (805) 643-2042



TRAXXAS

• **Pro Series Caster Blocks and Rake/Anti-Squat Adjusting Wedges**—With these new nylon caster blocks you can increase caster (front-tire lean in the corners) to the same number of degrees as the front kick-up on the chassis. On the Blue Eagle, Eagle, Hawk, Radicator and Bullet, increase caster to 25 degrees to improve low-speed steering. These blocks are great replacements for RC10 (add 30 degrees of caster).

Insert the new 1.5- and 3-degree nylon wedges under the front bulkhead to increase rake (front-suspension kick-up angle). Also use them with the Pro Series transmission to increase or decrease anti-squat geometry in the rear. The wedges fit Eagle, Blue Eagle, Hawk, Radicator and Bullet.

Part nos. 1932 (caster blocks); 1934 (wedges).

For more information, contact Traxxas Corp., 12150 Shiloh Rd., #120, Dallas, TX 75228.

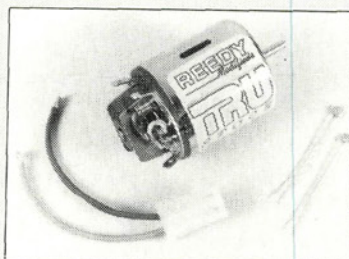
RPM

• **Heavy-Duty Rod Ends (4-40)**—These rod ends fit Losi, Associated and Yokomo trucks. Designed to be tough, they come in sets of 12.

Price: \$4.95/set

Part no. 7337

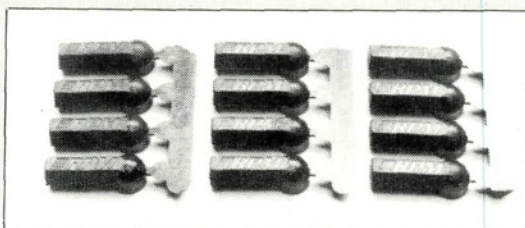
For more information, contact RPM, 14978 Sierra Bonita Ln., Chino, CA 91710.



REEDY MODIFIEDS

• **ROAR '91 Tru-Stock Motor**—Designed and built to the new ROAR specifications regarding stock motors, the Reedy Tru-Stock features: a maximum of 24 degrees timing for longer life; a commutator locking ring that meets ROAR specifications and limits the chances of armature tweaking; wet magnets for the torque needed in off-road racing; new slotted can to adjust the magnetic field for rpm and efficiency; heat-sink brush holders (if the motor runs cooler, it lasts longer and goes faster); silver-shunted, low-resistance brushes; Reedy "copper head" motor springs: proper brush tension (important for good motor performance); installation directions to help you reduce radio interference. The motor also offers Reedy Modifieds' World Championship-winning performance and reliability.

For more information, contact Associated Electrics Inc., 3585 Cadillac Ave., Costa Mesa, CA 92626.



Track Directory

YOUR 1992 TRACK GUIDE

ALABAMA

"Lil" TST R/C Raceway, 32 St. N., Alabama City, AL 35904; (205) 547-0071



ALASKA

ARCORR, Fairbanks St., Anchorage, AK 99507; Leon Fahrenthold, (907) 349-1950 evenings



ARIZONA

R/C Sports Mania, 3550 N. 35th Ave., Phoenix, AZ 85028; (602) 272-3165



ARKANSAS

AERCC, Vimy Ridge Rd., Little Rock, AR; (501) 945-7037



Arkansas Int'l. Superspeedway, Rt. 4, Stokes Rd., Pine Bluff, AR, 71602; (501) 247-1488



R-C Wheelz, 2630 Piko Ave., N. Little Rock, AR 72114; (501) 758-3330



CALIFORNIA

Desert R/C Raceway, 39360 3rd St. E., Suite 305, Palmdale, CA 93550; (805) 272-1835



Fast Eddie's R/C Raceway, 3261 Edward Ave., Santa Clara, CA 95054; (408) 986-8256



Frogtown R/C Raceway, Motherlode Hobbies, 3069 Hwy. 49, Angels Camp, CA 95222; (209) 736-4989



Lindsey's R/C Raceway, P.O. Box 443, Doyle, CA 96109; (916) 827-2457



Matt Norris' Fast Track, 8354 Marina Greens, Sacramento, CA 95826; (916) 381-0931



One-Stop Raceway, 3782 Cerritos Ave., Los Alamitos, CA 90720; (213) 493-7597



The Race Place, 13564 E. Imperial Hwy. Unit G, Santa Fe Springs, CA 90670; (213) 926-7711



Radio-Controlled Hobbies, 2011 Placentia Ave., Costa Mesa, CA 92630; (714) 631-1555



R/C Sports, 1009 Alamo Dr., Vacaville, CA 95688; (707) 446-5555



Roy's Raceway, 368 E. 11th St., Tracy, CA 95516; (209) 836-3513



SRS Raceway, 915 N. Main St., Salinas, CA 93906; (408) 424-4044



Trains, Planes, Automobiles, 1260 Oddstad, Redwood City, CA 94062; (415) 365-7500



Tyler's R/C R&D, 6865 Flanders #D, San Diego, CA 92121; (619) 597-3072



Woodbridge R/C Speedway, Irvine, CA. Contact Dave Anderson, (714) 551-5007



Yorba Linda R/C Speedway, 3780 Prospect, Suite B, Yorba Linda, CA 92686; (714) 572-2175



COLORADO

Action R/C Raceway, 4939 N. Broadway #57, Boulder, CO 80304; (303) 440-0330



Colorado R/C Speedway, 6520 Wadsworth Blvd. #130, Arvada, CO 80003; (303) 425-1718



Edora Park R/C Speedway, Edora Park, Ft. Collins, CO 80524; (303) 482-0197



R/C World & Track, 2788 S. Federal Blvd., Denver, CO 80236; (303) 789-0838



CONNECTICUT

Connecticut R/C Off-Roads, Old Field School, Mona Terrace, Fairfield, CT 06430; (203) 661-0145



High-Tech Raceway, 374 Enfield St., Enfield, CT 06082; (203) 745-8488



Hobby World Raceways, 161-6 Woodford Ave., Plainville, CT 06062; (203) 793-1111



K/N R/C Speedway Inc., West St., Stafford Springs, CT 06076; (203) 684-9896



R/C Raceways Inc., 1265 John Fitch Blvd., South Windsor, CT 06074; (203) 528-3661



R/C World/Sugar Hollow Speedway, 66 Sugar Hollow Rd., Danbury, CT 06810; (203) 748-2185



Wallingford Indoor Racing, 63 N. Cherry St., Wallingford, CT 06492; (203) 265-3939



FLORIDA

5-fifty-5 Raceway, County Road 555, Bartow, FL 33830; (813) 324-7406 (Chuck Nolke)



Coral Springs Roadrunners, P.O. Box 9632, Coral Springs, FL 33075; Tom Allison, (305) 721-0344 or Rick Schwartz, (305) 344-1983



H&H Raceway, 4121 S. Tamiami Tr., Sarasota, FL 34231; (813) 922-7711



Hialeah Hobby Raceway, 4562 W. 12 Ave., Hialeah, FL 33015; (305) 826-3702



Lou's R/C Hobbies & Raceway, 1512 SE Village Green Dr., Port St. Lucie, FL 34952; (407) 337-9000



M&M R/C Raceway, 16921 Waterline Rd., Bradenton, FL 34202; Mike Williams, (813) 747-2889



PBG R/C Motor Park, 4399 Lilac St., Palm Beach Gardens, FL 33410; (407) 524-9252



Pro Hobbies Speedway, 715 N. Lake Pleasant Road, Apopka, FL 32712; (407) 886-4615



Rental Raceway, 3655 S. Hopkins Ave., Titusville, FL 32780; (407) 383-0631



St. Augustine R/C Speedway, 99 Masters Dr., St. Augustine, FL 32095; (904) 824-6357



Sun Valley Speedway, Palmer Blvd., Sarasota, FL 34232; (813) 322-1200; (mailing address: Rt. 1, Box 443N, Myakka City, FL 34251)



West Coast R/C Club, Lake Park, 8607 May Cr., Tampa, FL 33614; (813) 932-3650



Wilbur Avenue Raceway, 1848 Wilbur Ave., Vero Beach, FL 32960; (407) 567-1200



GEORGIA

Case R/C Raceway, P.O. Box 1061, Trenton, GA 30752; (404) 657-6789



Dalton Raceway, 2300 Chattanooga Rd., Dalton, GA 30720; (404) 226-6699



Georgia Hobby Center, 112 Kenwood Rd., Fayetteville, GA 30214; (404) 460-1753



Peach Bowl R/C Speedway, 2035 Westside Ct., Snellville, GA 30278; (404) 985-1448



The Racer's Edge Raceway, 1530 Hwy. 19N, Thomaston, GA 30286; (404) 648-2637 or 648-6534



IDAHO

Falls Hobbies & R/C Raceway, 1515 Northgate Mile, Idaho Falls, ID 83401; (208) 529-8650



ILLINOIS

Ameri-Trac, R3, Box 242, Mattoon, IL 61938; (217) 234-8707



Badlands II, 320 W. Jackson St., Vandalia, IL 62471; (618) 283-2913



Eagle Speedway, 303 N. Plum St., Pontiac, IL 61764; (815) 842-1738



Hobby Town Raceway, 4915 W. Rt. 120, McHenry, IL 60050; Mike Hollingsworth (815) 344-1777



JC Hobbies/Metro Motor Speedway, Metropolis Airport, Metropolis, IL 62960; (618) 524-9979



Leisure Hours Hobbies, 2872 Plainfield Rd., Joliet, IL 60435; (815) 439-1477



Lisle Community Park Raceway, 1825 Short St., Lisle, IL 60532; (708) 416-6944 (Jim Bernicky)



Machesney Park, 1220 Shappert Dr., Machesney Park, IL 61111; (815) 282-1311



Monee R/C Raceway, 26049 Ridgeland Ave., Monee, IL 60449; (708) 534-2322



R/C Speed Zone, 1400 E. Lafayette, Bloomington, IL 61701; (309) 662-RACE



Redline Raceway, 921 Harding, Calumet City, IL 60409; (708) 862-8181



Slot Wing Hobbies Race Place, 1615 W. Springfield, Champaign, IL 61821; (217) 359-1920



Smithton Community Park, P.O. Box 8152, Belleville, IL 62221; (618) 236-7569



Superior Raceway, 1706 W. Bradley, Champaign, IL 61821; (217) 359-8073



Valley Farms R/C Raceway, 706 Bypass 20, Cherry Valley, IL 61016; (815) 332-4516



INDIANA

CC Hobby & Speedway, RR 1, Box 68, Francesville, IN 47946; (219) 567-2447



Gonzo Raceway, 418 Roberts Rd., Chesterton, IN 46304; (219) 980-8409



K&L Hobbies, 7 Raceway, 2751 N. State Rd. 39, La Porte, IN 46350; (219) 324-0353



Mooreville R/C Hobby, 7 Moore St., Mooreville, IN 46158; (317) 831-8877



Mooreville R/C Hobby, 9201 S. State Rd. 67, Camby, IN 46113; (317) 831-8877



R/C World of Indiana, RR #2, Box 335, Lynn, IN 47355; (317) 874-2464



Radio Car Craft, 1925 South Curry Pike, Bloomington, IN 47403; (812) 332-3245



IOWA

Mr. Car Raceway, Central Iowa Fairgrounds, Marshalltown, IA 50158; (515) 483-2234



North Park R/C Speedway, 805 S. Jerome, Algona, IA 50511; (515) 295-9352



Power House Racing, 1200 S. Division St., Creston, IA 50801; (515) 782-4582 or 782-4174



KEY TO SYMBOLS

- Indoor
- Outdoor
- Off-road
- Oval
- Dirt oval
- Carpet
- Concrete
- Asphalt
- On-site
- hobby shop
- AC power
- Automatic lap-counting
- Food available

Track Directory

Rotunda Raceway, 101 Bass, RR 1 Box 155A, Storm Lake, IA 50588; (712) 732-4555



Team Johnson Speedway, Jct. Hwy. 34 & 406, West Burlington, IA 52655; (319) 753-0753



KANSAS

Chad's R/C World & Raceway, 217 Brownie Ave., P.O. Box 76, Scranton, KS 66537; (913) 793-2313



Pittsburg International Mini Speedway, 511 1/2 N. Locust, Pittsburg, KS 66762; (316) 232-1973



R/C Superdome & TQ Pro Shop, 14 East Avenue A, Hutchinson, KS 67501; (316) 665-6633



Spring Creek Raceway, 7257 W. Schilling Rd., Salina, KS 67401; (913) 823-8588



KENTUCKY

Fast Lane Hobbies, 6132 Scottsville Rd., Bowling Green, KY 42104; (502) 782-2419



The Lexington Autodrome Raceway, 2753 Richmond Rd., Lexington, KY 40509; (606) 269-7794



Remote-Control Hobby Shop/Raceways, Rt. 8, Box 211, Mayfield, KY 42066; (502) 247-4715



LOUISIANA

Acadiana R/C Hobbies & Raceway, 120 Toledo Dr., Lafayette, LA 70506; (318) 235-5825



Cajun R/C Raceway, Rt. 2, Box 288 Hwy. 343, Church Point, LA 70525; (318) 873-3855



MAINE

Central Maine R/C Speedway, 18 Lithgow St., Winslow, ME 04901; (207) 877-2232



Rocket R/C Hobbies, Annabessacook Rd., Winthrop, ME 04364; (207) 377-6910



Team Terminator Off-Road Track, c/o Hobbies Plus, 479C Elm St., Biddeford, ME 04005; (207) 282-8838



The Racers' Club, 85 Hubbard Rd., P.O. Box 160, Berwick, ME 03901; (207) 698-5337



MARYLAND

Doug's Hobby Shop Raceway, Rt. 301N, Box 32B, Waldorf, MD 20601; (301) 843-7774



Friendship Off-Road Racers, 1531 Florida Ave., Severn, MD 21144; (301) 551-3050



Off-Road Headquarters Indoor Raceway, 5640 K Sunnyside Ave., Beltsville, MD 20705; (301) 474-1246



Suzie Goose Hobbies, 718 E. Gude Dr., Rockville, MD 20850; (301) 279-2966



MASSACHUSETTS

Archer's Lane R/C Raceway, 118 Washington St. (Rt. 1), S. Attleboro, MA 02730; (508) 399-6762



CKS Raceway, 46 Wilbraham St., Palmer, MA 01069; (413) 283-2260



Megadrome Raceway, North Adams Plaza, Rt. 8, North Adams, MA 01247; (413) 743-7223



Mike's Speedway, Rt. 9, Mt. Farms Mall, Hadley, MA 01035



R/C Hobbies & Speedway, 1311 Purchase St., New Bedford, MA 02740; (508) 991-5040



West St. Hobbies, 114C Main St., Medway, MA 02053; (508) 533-1231



MICHIGAN

Baja Bayou Off-Road Raceway, 5313 West 22 Mile Rd., Tustin, MI 49688; (616) 829-3447



Can-Am Hobbies Speedway Park, 1148 Gratiot, Marysville, MI 48040; (313) 364-3338



Cereal City R/C Off-Roaders, 2000 E. Columbia Ave., Battle Creek, MI 49015; (616) 963-2506



Ludington R/C Raceway, 1483 N. Dennis Rd., Ludington, MI 49431; (616) 843-4654



More R/C Club, 33538 23 Mile Rd., Chesterfield Township, MI 48047; (313) 773-5918 (Tom Kelly) or 749-9774 (Joe)



Off-Road Speedway, 1940 Lakeville Rd., #28, Oxford, MI 48371; (313) 628-4320



R&L Hobbies, 10334 Portage Rd., Portage, MI 49002; (616) 323-3686



R.G. Enterprises, 600 N. Lafayette, Greenville, MI 48838; (616) 754-4919



USA Raceways, 6083 Dixie Hwy., Bridgeport, MI 48722; (517) 777-7USA



MINNESOTA

Minn-E-Golf & Hobby, 9100 Park Ave., Elk River, MN 55330; (612) 441-8365



MISSISSIPPI

Precision Hobbies, 240 Eisenhower Dr., Biloxi, MS 39531; (601) 388-6346



Small Cars Unlimited, 820 Cooper Rd., Jackson, MS 39212; (601) 372-FAST



MISSOURI

Outback Speedway & Hobby, 2810 Sutton Blvd., Maplewood, MO 63143; (314) 644-3383



R + Hobby, 590 Jungermann Rd., St. Peters, MO 63376; (314) 928-9838



KEY TO SYMBOLS

- Indoor
- Outdoor
- Off-road
- Oval
- Dirt oval
- Carpet
- Concrete
- Asphalt
- On-site
- hobby shop
- AC power
- Automatic
- lap-counting
- Food available

MONTANA

Bozeman R/C Powerhouse Track, west side of the Main Mall, Bozeman, MT 59715; (406) 586-6461



Garden City Raceway, 6725 Hwy. 10 West, Missoula, MT 59802; (406) 721-5405



Magic City R/C Raceway, 14th St. W. & Central Ave., Billings, MT 59101; (406) 259-9004



NEW HAMPSHIRE

4-K Racing, 100 Warwick Rd, Winchester, NH 03470; (603) 239-6207



C.T. Hobbies R/C Raceway, 49 Eaton Rd., Auburn, NH 03032; (603) 483-2274



Hobbies Plus R/C Raceway, 14 Celina Ave., Nashua, NH 03063; (603) 882-9200



R&B Racing, Lily Pond Rd., Gilford, NH 03246; Louie, (603) 524-2909 or Bud (603) 524-1893



NEW JERSEY

Action Raceway, Rt. 295 & Harmony Rd., Gibbstown, NJ 08027; (609) 423-8933



Glassboro's Grand Oval Speedway, 167 S. Delsea Dr., Glassboro, NJ 08028; (609) 863-1551



L.B.R.A. Track, 392 Warburton Pl., Long Branch, NJ 07740; (908) 222-5122



The Race Place, Rt. 33 & 34, Farmingdale, NJ 07727; (908) 938-5215



Radical Raceway & Hobbies, 100 Rt. 17S, Lodi, NJ 07644; (201) 834-6996



Tri-Oval Speedway & R/C Center, 296 S. Main St., Phillipsburg, NJ 08865; (908) 454-2223



Zeppelin Hobbies & Raceway, 92 Rte. 23N, Riverdale, NJ 07457; (201) 831-7717



NEW MEXICO

Racers Inn, 4300 Rankin Lane NE, Albuquerque, NM 87107; (505) 345-5988



NEW YORK

A&D's FasTracks, 1000 N. Main St., Brewster, NY 10509; (914) 279-2065



A&S Race Center & Hobbies, 120 Cayuga St., Canalview Mall, Fulton, NY 13069; (315) 598-2772



Bellmore Raceway, 2479 Charles Ct., Bellmore, NY 11710; (516) 783-3456 or 783-0105



Dirt Track, 17 Fairway Dr., Manorville, NY 11949; Billy Wroblewski (516) 878-0737



East End Off-Roaders, Route 25A at Gull's Square, Wading River, NY 11792; (516) 929-8844



Island Hobbies & Raceway, 410 Commack Rd., Deer Park, NY 11729; (516) 254-6229



Lakeside Raceway & Hobbies, 712 Willow Ave., Ithaca, NY 14850; (607) 272-0248



Latest Hobbies & Raceway, Rt. 25A, Wading River, NY 11792; (516) 929-8844



Long Island 1/4-Scale Racers, 63 Horton Dr., Hunt Station, NY 11746; (516) 351-5384



Maspeth Raceway, Rust St. & 57th Rd., Maspeth, NY 11378; (718) 894-0800



Queens Off-Roaders, 42-12 13th St., Long Island City, NY 11101; (718) 392-5766



R/C Competition Corner, K-Mart Plaza, Mattytale, NY 13211; (315) 455-8718



R/C Hobbies, Rt. 49, Box 138, Constantia, NY 13044; (315) 623-9536



Riverside R/C & Hobby, P.O. Box 125, Rt. 126, Beaver Falls, NY 13305; (315) 346-1682



Schoharie Co. R/C Car Club, P.O. Box 126, Cobleskill, NY 12043; (518) 234-4600



Skaneateles Raceway & Hobby, P.O. Box 102, Rt. 20, W. Genesee St., Skaneateles, NY 13152; (315) 685-8077



Walt's Hobby, 2 Dwight Park Dr., Syracuse, NY 13209; (315) 453-2291



NORTH CAROLINA

Cape Fear Speedway, 107 Harley Rd., Wilmington, NC 28401; (919) 762-1184



Charlotte R/C Raceway & Hobbies, 5820 Old Concord Rd., Charlotte, NC 28213; (704) 597-0608



Granite City R/C Raceway, 192-1 N. Main St., Mt. Airy, NC 27030; (919) 786-1466



Jacksonville International Speedway, Hwy. 17N, Jacksonville, NC 28540; (919) 346-1522



Joe's Hobby Shop & Raceway, Rt. 2, Box 682-B, Bessemer City, NC 28016; (704) 435-2912



Mountain R/C Raceway, Hwy. 107N, P.O. Box 67, Glenville, NC 28736; (704) 743-3709



Reedy Creek Raceway, Rt. 14, Box 946, Conard Sowers Rd., Lexington, NC 27292; (704) 731-4022



Sandhills Raceway, Inc., US #1 South, Aberdeen, NC 28315; (919) 944-7414



Smiley Face Raceway, 120 W. Center St., Mebane, NC 27302; (919) 563-3822



TLC R/C Raceway, Rt. 6, Box 321-A, Hwy. 601, Mocksville, NC 27028; (704) 492-7569



NORTH DAKOTA

Crystal Springs Off-Road, 1200 53 Ave. SW, Minot, ND 58701; (701) 852-9590



Track Directory

OHIO

Alcraft's R/C Raceway, 1370 Custer-Orangeville Rd., Brookfield, OH 44403; (216) 448-1573



CRC Raceway/Toy Train Hobbies, 1015 Lower Bellbrook, Xenia, OH 45385; (513) 372-6806



Hobby Main Raceway, 6597 Route 244, Lowellville, OH 44436; (216) 536-8282



Innovative Hobbies/Lakeside Speedway, 3427 Manchester Rd., Akron, OH 44319; (216) 645-1333



KAR R/C Raceway, 14511 Seacrist Rd., Salem, OH 44460; (216) 537-4039



Mid-Ohio R/C Raceway, 5367 Fishburg Rd., Huber Heights, OH 45424; (513) 233-2807



Way Out Hobbies, 5583 Centerpoint Rd., Georgetown, OH 45121; (513) 375-4984



OKLAHOMA

Off-Road R/C Autos of Tulsa, 13349 E. 11th #B, Tulsa, OK; (918) 251-5592



OKC Raceway, 6707 NW 10th, Oklahoma City, OK; (405) 495-4820



OREGON

Buggy Boogie Race Track, Rt. 4, Box 546, Astoria/Knapka, OR 97103; (503) 458-5357



R/C Plus Hobbies Raceway, 2029 25th St. SE, Salem, OR 97302; (503) 364-9188



R/C Speed Center, 2810 N. Pacific Hwy., Medford, OR 97501; (503) 779-8298



PENNSYLVANIA

Brian's Raceway, 733 Flexer Ave., Allentown, PA 18103; (215) 435-1862



Cressona Mall Speedway, Rt. 61, Pottsville, PA 17901; (717) 385-3506



East St. Raceway & Art Center, 747 E. Railroad Ave., Verona, PA 15147; (412) 826-0602



High-Tek Hobbies Raceway, 13250 Rt. 30, North Huntingdon, PA 15642; (412) 864-5278



Koontz's Home & Hobby Center, 1205 Hoover St., Pittsburgh, PA 15204; (412) 331-3866



L&R R/C Racing, 15 S. Main St., Red Lion, PA 17356; (717) 244-1108



Modellbahn Ott Hobbies, 1145 E. Philadelphia Ave. (Rt. 73), Gilbertsville, PA 19525; (215) 367-5925



Performance Hobby, 1305 Main St., Slatington, PA 18080; (215) 760-9855



Prop & Wheels Raceway, 139 W. Broadway, Tamaqua, PA 18252; (717) 668-2288



Radio Controlled Pro Speedway, Rt. 487N, Stillwater, PA 17878; (717) 387-0266



T&T Radio Controlled Racing, Randolph Rd., Great Band, PA 18821; (607) 723-9357



Wagonhill Hobbyland, RD3, Box 183, Slippery Rock, PA 16057; (412) 458-4711



RHODE ISLAND

East Bay Hobbies, 629 Metacom Ave., Bristol, RI 02809; (401) 254-0778



R/C Hobbies, 47 Sandybottom Rd., Coventry, RI 02816; (401) 823-4335



SOUTH CAROLINA

Berea R/C Speedway, 707 Sulphur Springs Rd., Greenville, SC 29611; (803) 246-4702



Inland R/C Speedway, 61 New Found Lane, Myrtle Beach, SC 29577; (803) 293-1753



LB Co. Hurricane, 112 Green Acres Rd., Blythwood, SC 29016; (803) 786-0984



Palmetto Raceway, 5023A Rivers Ave., N. Charleston, SC 29418; (803) 566-0068



TBS Superspeedway, Hwy. 151, Darlington, SC 29532; (803) 395-1551 or 332-7117



SOUTH DAKOTA

Dakota Off-Road Racers, 2989 W. Br. Co. 12, Aberdeen, SD 57401; (605) 226-0604



TENNESSEE

The Dirt Dome, 575 W. Poplar Ave., Memphis/Collierville, TN 38017; (901) 853-3428



TEXAS

Budget Raceway, RR 1, Box 400 I-35, Bruceville, TX 76630; (814) 859-5296



Finish Line Hobby Store & Raceway, 11925 Jones Maltsberger, San Antonio, TX 78016; (512) 491-0088



Hal's R/C Raceway, 1440 Bessemer, El Paso, TX 79936; (915) 591-2213



Hi-Tech Hobbies, 1107 Port Neches Ave., Port Neches, TX 77651; (409) 724-2391



Indy R/C World, 220 Mesquite Village, Mesquite, TX 75150; (214) 686-7744



R/C Pro Shop, 3303 N. Midkiff, Midland, TX 79705



Spring Creek R/C, 45 Fisherman's Rd., San Angelo, TX 76904; (915) 944-3850



TK's R/C Park, 2921 Old Claude Hwy., Amarillo, TX 79101; (806) 622-0017



UTAH

W.O.R. Raceway, 3150 Brinker Ave., Ogden, UT 84401



VERMONT

Silver Towers Raceway, Elks Club, North Ave., Burlington, VT 05401; (802) 658-4490



VIRGINIA

Bob's Hobbies & Raceway, 910-J Brandycreek Dr., Mechanicsville, VA 23111; (804) 746-2758



Cooper's R/C Raceway, Rt. 4, Box 12203, Chatham, VA 24531; (804) 724-4182



Mid Atlantic Raceway, 89 East Elizabeth St., Harrisburg, VA 22801; (703) 433-3952



The Race Place, 3180 King William Ave., Westpoint, VA 23181; (804) 843-4933



Winners Circle, 3236 W. Clay St., Richmond, VA 23230; (804) 355-7076



WASHINGTON

Alfie's, 108 South K St., Aberdeen, WA 98520; (206) 533-6638



Four Seasons R/C Racing, 146 School St. SE, Olympia, WA 98506; (206) 491-2430



Hank Perry Race Complex, Sullivan Rd., WA 99213; (509) 927-1879



Tacoma R/C Raceway Hobbies, 6305 6th Ave., Tacoma, WA 98406; (206) 565-1935



WEST VIRGINIA

R/C Race Place, Rt. 10, Box 351, Morgantown, WV 26505; (304) 292-0811



WISCONSIN

Frog's R/C Raceway, Rt. 1, Phillips, WI 54555; (715) 339-2314 or 339-2958



Hobbytown Speedway, 4231 8th St. S., Wisconsin Rapids, WI 54494; (715) 421-1222



Hobby World Speedway, 3198 London Rd., Eau Claire, WI 54701; (715) 834-0456



Maniac Motors Raceway, 244 Rt. 1 A1 Rt. H, Kendall, WI 54638; (608) 847-4833



The Pits Hobby Shop, 786 Morris Ave., Green Bay, WI 54304; (414) 494-4200



West Bend Hobbies, 144 N. Main St., West Bend, WI 53040; (414) 334-0487



CANADA

Autodrome des Prairies, 935 Boul. St-Luc, St-Luc, Quebec J0J 2A0; (514) 348-0718



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CITY _____

STATE _____ ZIP _____

PHONE (REQ'D.) () _____

Track area: _____ x _____ feet (length x width)

(Check all that apply)

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| ☐ Indoor | ☐ Concrete |
| ☐ Outdoor | ☐ Asphalt |
| ☐ Off-road | ☐ On-site hobby shop |
| ☐ Oval | ☐ AC power |
| ☐ Banked | ☐ Automatic lap-counting |
| ☐ Dirt | ☐ Food available |
| ☐ Carpet | ☐ Handicap access |

Return to Track Directory, *Radio Control Car Action*, 251 Danbury Road, Wilton, CT 06897

ASSOCIATED

RC10

STADIUM TRUCK

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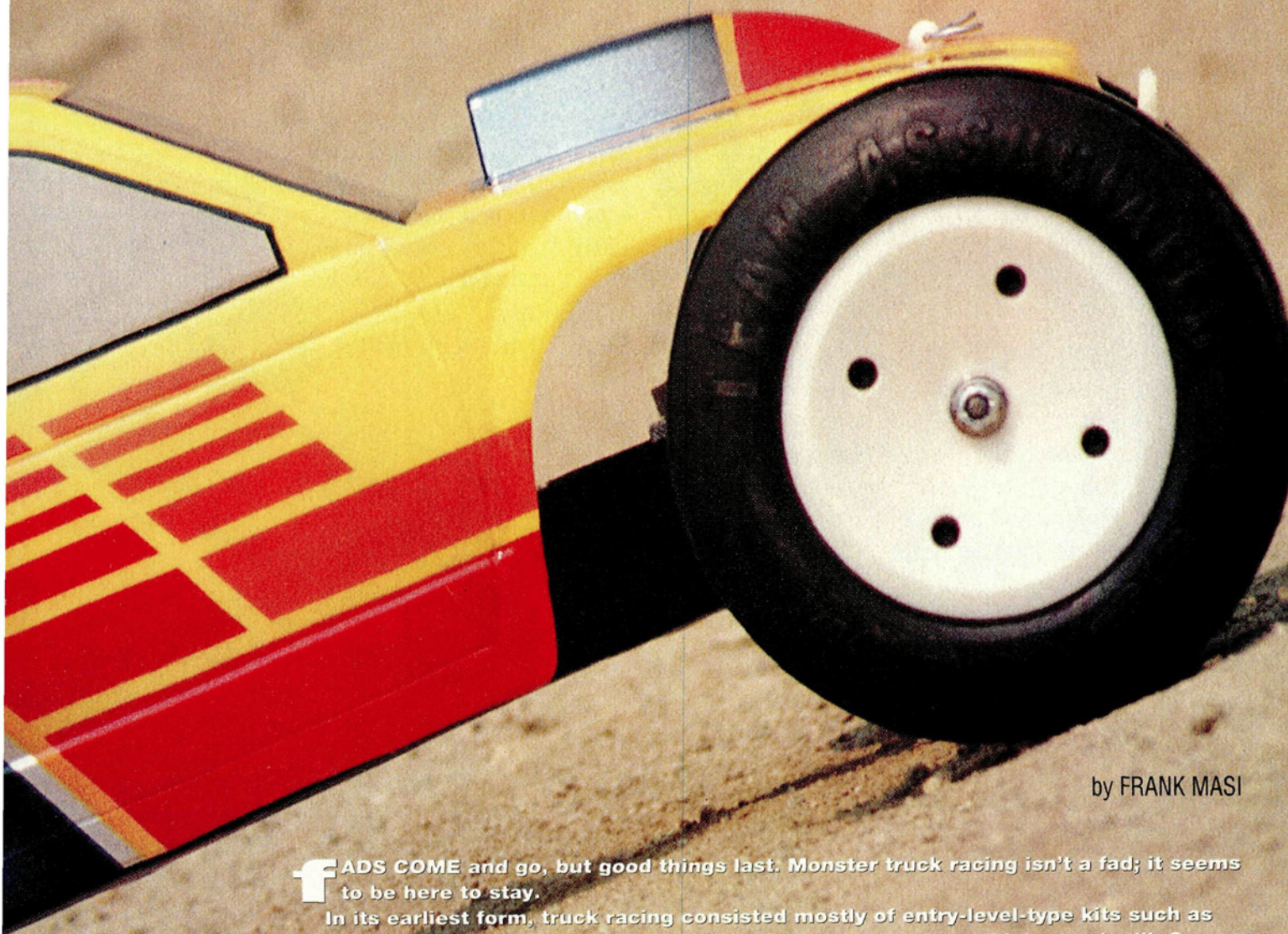
QUEENS OFF ROADERS



REEDY

TEAM ASSOCIATED
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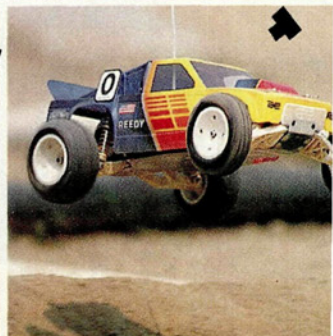
by FRANK MASI

FADS COME and go, but good things last. Monster truck racing isn't a fad; it seems to be here to stay.

In its earliest form, truck racing consisted mostly of entry-level-type kits such as the Tamiya Blackfoot and the Marui Big Bear, but technology didn't stand still. Soon, manufacturers were producing conversion kits that enabled racers to turn their 2WD off-road cars into racing trucks. As the popularity of these converted racing trucks grew, purpose-built racing trucks began to emerge until they bore more resemblance to stadium racers than to actual monster trucks. Team Losi's JRX-T and Traxxas' Eagle and Blue Eagle were among the first of these out-of-the-box racing trucks, and a new segment of R/C racing was born.

it's T time!

PHOTOS BY STEVE POND



At this year's prestigious Florida Winter Championship race, Team (Moo) Associated* unveiled its new RC10T Stadium Racing Truck, which placed first

front A-arms, minimizes the truck's tire scrub, i.e., its tires' lateral movement over the track's surface.

Associated's 1.02-inch hard-anodized Team Shocks are

used to damp the front end, which, owing to the longer A-arms and larger-diameter truck tires, has significantly more travel than the RC10. To make the most of the new suspension, a longer fiberglass shock tower was added. This shock tower is attached to an all-new bulkhead that features an aluminum cross-brace that increases the durability of the front A-arm mount.

Also new up front is a neat nylon front bumper that's bolted to the the kick-up plate. This should be quite effective at limiting the amount of "plowing" that might occur if the truck nose-dives over a jump.

Associated must have listened to the input of its racing clientele; it has finally designed a steering bellcrank system that offers

The new, molded-nylon, front A-arms are the result of intensive R&D. Associated took more than a year to design the RC10T. Longer turnbuckle linkage comes with the kit, so static adjustments can be made quickly and easily.

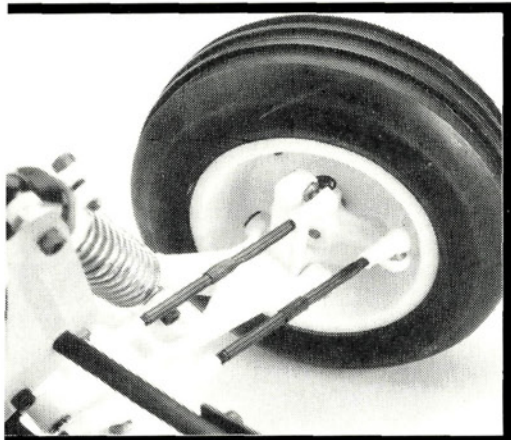
and second at this world-class event.

Associated was swamped with orders for this truck, which, at the time, wasn't quite ready for production (the team's trucks were prototypes). Associated truck mania ensued; it seemed as if everybody wanted one. Well, now it's here, and it's time to see whether the RC10T can fulfill our expectations.

NOT JUST BIG TIRES

Is the RC10T just an ordinary RC10 with big tires and a racing truck body? No way, José! The only parts this truck shares with the RC10 are its 15-degree caster blocks, in-line steering blocks, main chassis tub, battery box and, of course, its Stealth transmission. Everything else on the T has been newly designed just for the truck.

Up front, the RC10T's kick-up plate is narrower than that of the RC10. This, combined with the extra-long



Type Off-road racing truck
Scale 1/10
Price \$349

DIMENSIONS:

Overall Length 16.25 inches
Width 12.625 inches
Wheelbase 11.125 inches
Front Track 8.25 inches
Rear Track 8.375 inches

WEIGHT:

Gross (w/bat.) .. 3 pounds, 13.6 ounces

BODY:

Type Stadium racing truck
Material Polycarbonate

CHASSIS:

Type Stamped tub
Material Aluminum

DRIVE TRAIN:

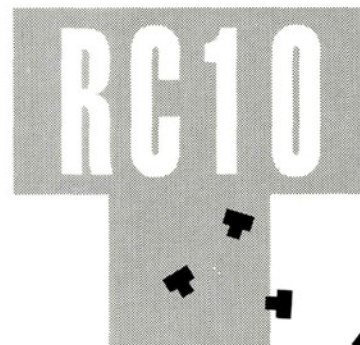
Primary Pinion/spur
Transmission Gear drive
Differential Ball diff
Bearings/Bushings Ball bearings

SUSPENSION:

Type (f/r) Single A-arm
with upper camber link
Damping (f/r) Oil-filled,
coil-over shocks

WHEELS:

Front: Type .. Three-piece nylon
Dimensions (DxW)
2.19x1.25 inches
Rear: Type ... Three-piece nylon
Dimensions (DxW)
2.31x2.0 inches



SPECIFICATIONS

TIRES:

Front Narrow ribbed 7871
Rear Pin spike/paddle 7820

ELECTRICS:

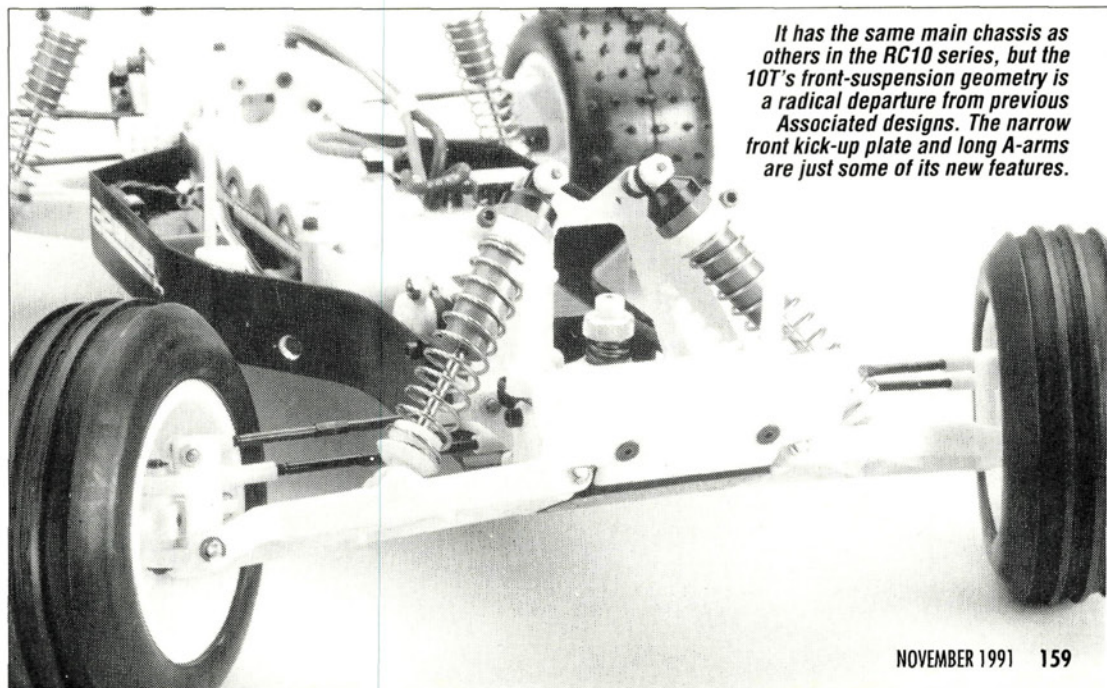
Motor Not Included
Battery Not Included
Speed Controller . Not Included

OPTIONS AS TESTED:

KO Propo EX-1 transmitter;
Novak 410-M1c ESC and NER-
2X micro-reciever; Powerline
matched 6-cell SCE pack; Reedy
Ultra Series Mr K motor; Futaba
S-9301 coreless ball-bearing
servo.

COMMENTS:

Definitely one of the hottest out-of-the-box race trucks on the market. The quality of its parts is better than that of Associated's other off-road kits. Setup is easy, and the RC10T is extremely stable, even on rough tracks.



It has the same main chassis as others in the RC10 series, but the 10T's front-suspension geometry is a radical departure from previous Associated designs. The narrow front kick-up plate and long A-arms are just some of its new features.

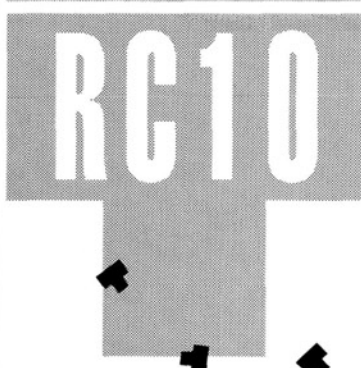
the same features as the after-market setups that many RC10 owners have been using. The new RC10T bellcranks incorporate a built-in servo-saver that can be adjusted to a desired sensitivity.

TAIL GATE FEATURES

You'll find just as many new parts on the truck's rear as you do on its front. The rear bulkhead is the same as the one found on the RC10, but attached to it is a new fiberglass shock tower that works with the truck's wider A-arms and stance. Although the A-arm mounts have 1 1/2 degrees of toe-in (as they do on the RC10), the hub carriers are new. They have another 1 1/2 degrees of toe-in built in (for a total of 3 degrees), and they raise the camber rod's position slightly.

As with any kit intended for serious racers, the RC10T comes standard with turnbuckle suspension linkage that makes camber adjustments and toe adjustments quick and easy.

Of course, the excellent Stealth transmission is used on the truck, and it should work just as well in the RC10T as it does in



"It was easier to build the truck than it was to put the Team Car together."

the Associated Team Car. Instead of the universal-joint drive shafts found on the Team Car, however, the RC10T has conventional

dogbones with separate axles. Obviously, the Team Car's U-joints are far too short to be used on the

truck, so my guess is that longer universal-joint shafts will be available soon (perhaps by the time you read this). I wager that the truck comes with dogbones instead of U-joints because the dogbones can be mass-produced more cheaply and more quickly. To expedite the kit's release and keep its price competitive, dogbones were used until the costly tooling for the longer U-joints had been perfected. When they're cost-effective, I'm sure either Associated or an after-market manufacturer will produce them.

The RC10T's rear shocks are also Associated's hard-anodized, Teflon-coated shocks, but they're longer than those used in the front (1.32 inch).

RACING RUBBER

At the Florida Winter Champs, the Associated drivers used new, narrow, front wheels and tires—something not seen before on a racing truck. Many objected to their use, saying that scale appearance was being compromised, and ROAR subsequently banned their use at sanctioned events. For this reason, the RC10T comes with both the controversial narrow, ribbed

front tires (part no. 7871) as well as a pair of wide, ROAR-legal block ribbed fronts (part no. 7870). As for rear tires, the kit includes a pair of pin-spoke tires with center paddles (part no. 7820).

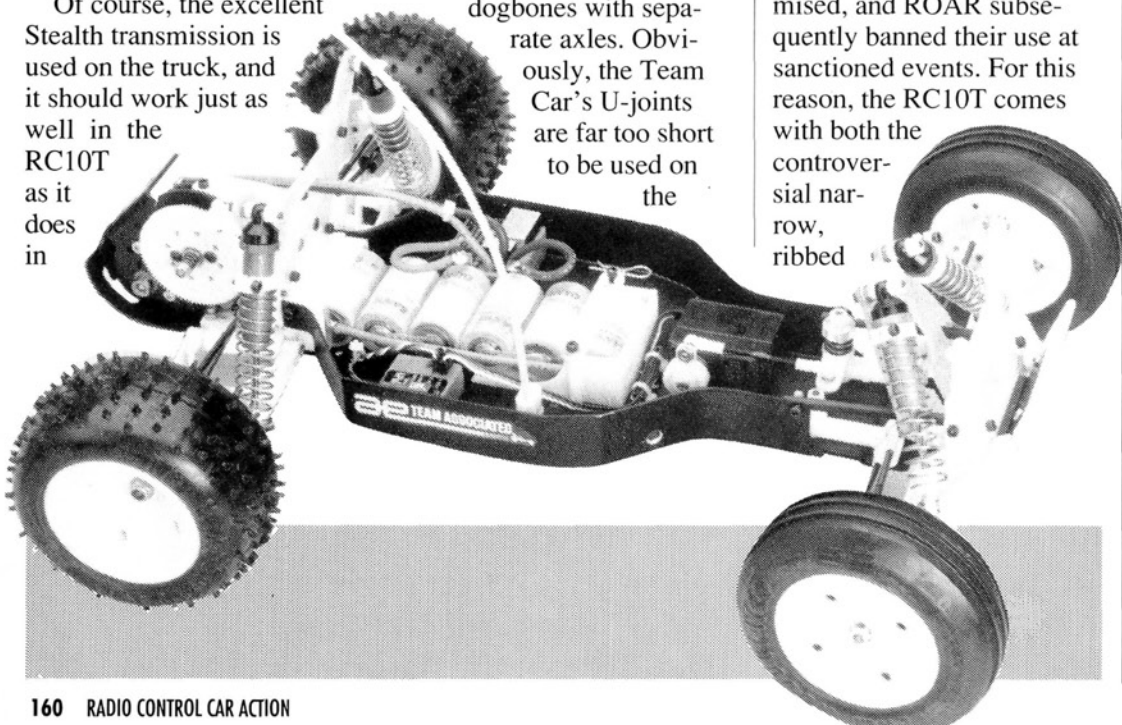
The RC10T features all-new, three-piece rims that can be bolted together. They hold the tires firmly and eliminate the need to glue the tires on.

ASSEMBLY

The RC10T's construction went smoothly. All the parts are sealed in poly bags and grouped according to the order of assembly. That way, you don't have to open more than one bag for a specific construction step. The instruction manual for the RC10T is a vast improvement on previous Associated offerings (exception: the manual for the Team Car was also excellent). The pictures are clear, and the corresponding text is easy to follow.

Possibly the only flaw in Associated's RC10 is its "buildability." Some of the older parts (mostly the nylon suspension components) have inexact tolerances and fit poorly, so they require more attention during assembly. This isn't the case with the new truck. I've noticed, especially with the Stealth transmission, that Associated's newly designed parts appear to be of a higher quality than the older, carry-over parts from the original RC10.

It was easier to build the truck than it was to put the Team Car together. The new arms fit the suspension pins more precisely, and it takes no extra time or effort to install the new bellcrank steering system properly. The

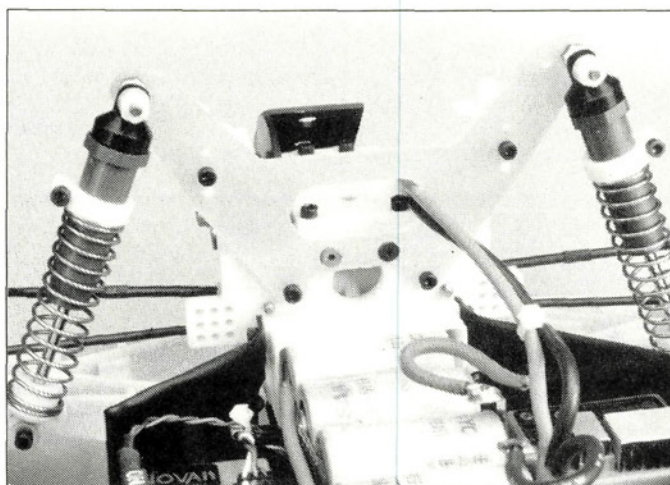


only minor nuisance I encountered was the excessive molding flash on the shock spring collars and retainers. (Flash is the extra material that remains on a molded part after it has been removed from the mold.) I had to slice it off with a knife.

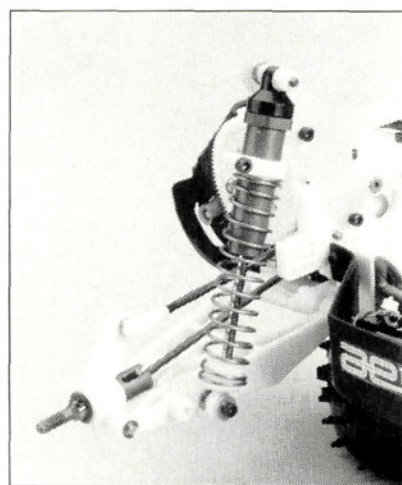
While building the truck, I noticed some subtleties never before found on standard Associated off-road kits. When I reviewed the Team Car, I mentioned that, owing to the angle at which the rear shocks were attached to the A-arms, there would be a little binding when the suspension moved through its full range of travel. This was fixed by spacing the lower rear shock mount about $\frac{1}{8}$ inch away from the A-arm, to allow the shock to travel more in the same direction as the suspension arm did. On the RC10T, not only has the geometry been improved so that the shock angle and the A-arm are better aligned, but Associated has also redesigned the upper shock-mount bushing. It allows the shock to pivot not only from side to side, but also from front to back, so effectively eliminating any binding.

A pleasant surprise! Associated includes servo tape with the kit. I don't mean the little strips that most manufacturers include with their kits—usually, just enough to get the job done—but an actual roll of servo tape that I used on two other projects, too. Hey! Little things make a difference.

Red light! One more minor complaint: the RC10T's aluminum chassis tub, which was introduced in '84 on the RC10, *still* has its



■ *Left: Although the truck's rear bulkhead is the same as the RC10's, the fiberglass shock tower that's attached to it was designed exclusively for the truck's wide-stance suspension.* ■ *Right: On the rear, the 10T has long A-arms that resemble those on the front. Longer dogbones and hub carriers with more built-in toe-in are new features.*



battery-cup mounting holes in the wrong positions! This may seem trivial, but not only are the holes off-center, but they're also too close to the rear bulkhead to allow the use of a saddle-pack type battery. C'mon, guys, nobody uses stick packs much nowadays! If you want to run saddle-pack batteries, you'll have to drill and countersink a new set of holes in the right positions.

Back to construction. If you follow the manual closely (and I recommend that you do) it won't take you much more than eight hours to complete the job. There really aren't any tricks to building the truck, but attention should be paid to the tranny's assembly. It's critical that you adjust the differential according to the instructions. Tighten the diff until you feel the diff spring begin to bottom-out (I said *begin!*), and then "back off" on the adjusting screw an eighth to a quarter of a turn. Owing to the increased load of the bigger truck tires and rims, this is even more important here than it is on the Team Car.

GUIDANCE SYSTEMS

After I had completed the chassis, it was time to install the electronics. I chose a Futaba* S9301 coreless, ball-bearing servo to handle the bellcrank bashing, and Novak's* 410-M1c high-frequency electronic speed controller transfers the battery's power to the Reedy Modified's* Mr K 17-turn quad Ultra Series motor. I chose a KO-Propo* EX-1 radio, and I replaced the stock receiver with a Novak NER-2X micro receiver.

PICKUP PAINTING

As I mentioned earlier, the RC10T is more like a stadium racing truck than a monster truck, and so its body was designed after the stadium trucks like the ones that compete in the Mickey Thompson Grand Prix. I think it looks great.

Somebody out there must like me! Painting truck bodies isn't something I look forward to. Luckily, I received a beautifully painted body with the kit. Life just seems to get better and better....

FROM THE TOP

Before building the kit, I asked Associated's Cliff Lett what kind of setup would be good to start out with. He told me that Associated's 30WT silicone oil in all four shocks would work well on most tracks, and that I should use only the kit's Gold springs. As far as static adjustments, Cliff said that the truck should be run with about 1 degree of negative camber in the rear and around 1 or 2 degrees of negative camber up front, with no toe-in or toe-out on the front tires.

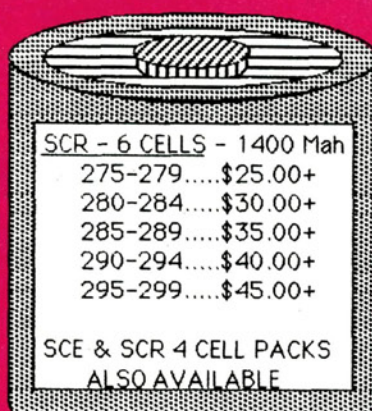
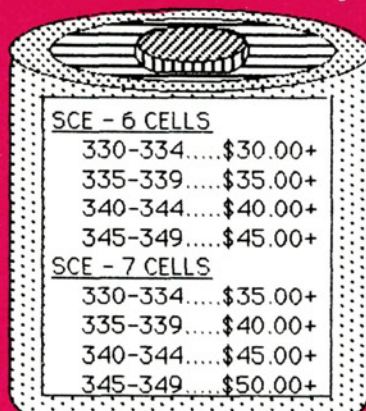
Ride height should be set as follows: with all the running gear (batteries, motor, etc.) installed, the front end should sit about $\frac{1}{4}$ inch below its full extension, and the rear A-arms should be parallel with the ground.

STADIUM STOMPING!

On the track, the RC10T was nearly infallible. It handled jumps and moguls effortlessly and had a fairly good amount of turn-in (something not always found on a racing truck).

(Continued on page 164)

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NITRO NEWS

(Continued from page 111)

makes changing a tire as easy as pulling one off and putting another on—a great feature, since longer races may require one or more tire changes (just like the big boys).

So what's so special about gas-powered cars? Their suspension systems are very similar to those of some electric cars, but their speed, smell and sound set them apart. If you've been into electrical cars for a while, it's time to go nitro!

**Here are the addresses of the companies mentioned in this article:*

Serpent; distributed by RC Motor Sports of Miami, 4715 N.W. 157 St., Ste. 204, Miami, FL 33014.

Delta Manufacturing, Inc., 27 Racecar Court, Lorimer, IA 50149.

PB Sales and Racing, Inc., P.O. Box 51589, New Berlin, WI 53152. ■

RC10T

(Continued from page 161)

The truck's initial setup seemed nearly perfect—if such a thing is possible—and it instilled a lot of confidence in us. Partial credit for the truck's performance must be given to the wheels and tires, but the excellence of the RC10T's handling is made possible by the great new suspension. This truck is stable!

Team Associated has a definite winner on its hands with the new RC10T. The high quality of the parts shows that Associated realizes that those who buy its products expect a lot for their hard-earned dollars.

A lot of time and money went into the new truck, and it shows—on the track and on the workbench. I still wish that Associated would drill the battery-mounting holes in the right positions and look out for some of the excess flashing, but, all in

(Continued on page 170)

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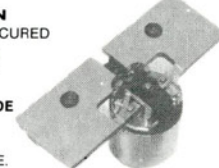
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RC10T

(Continued from page 164)

all, this is a hot offering. As someone who once considered truck racing a novelty and a facet of the sport that wasn't for serious racers, I've been converted. This truck is serious!

**Here are the addresses of the companies mentioned in this article:*

Team Associated, 3585 Cadillac Ave., Costa Mesa, CA 92626.

Futaba Corp. of America, 4 Studebaker, Irvine, CA 92718.

Novak Electronics Inc., 128-C E. Dyer Rd., Santa Ana, CA 92707.

Reedy Modified; distributed by Associated.

KO Propo; distributed by Global Hobby Distributors, 10725 Ellis Ave., Fountain Valley, CA 92728.

PROJECT LAZER

(Continued from page 145)

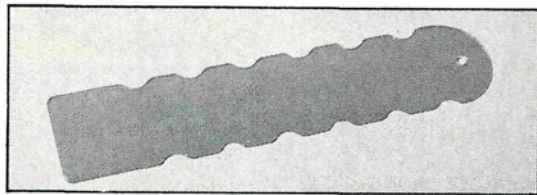
incredibly rigid, there's a lot that can be cut out of the lower plate. The easiest way to determine what goes and what stays is to lay out all your running gear (i.e. electronic speed controller [ESC], servo, etc.) on the chassis and then draw rough outlines of these parts on the chassis. To be on the safe side, don't cut too much!

(Continued on page 185)

PARTS, PARTS... WE'VE GOT PARTS!

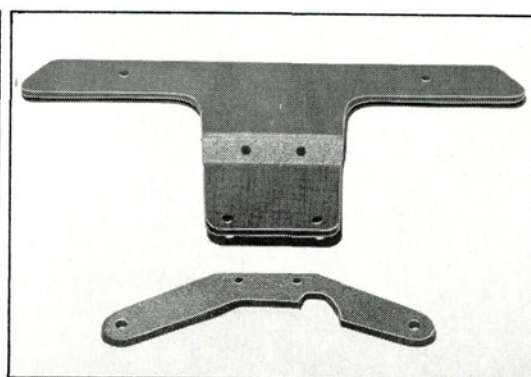
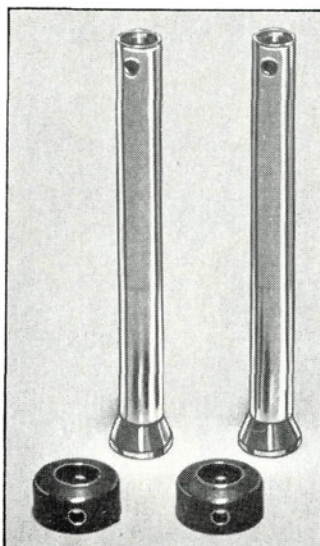
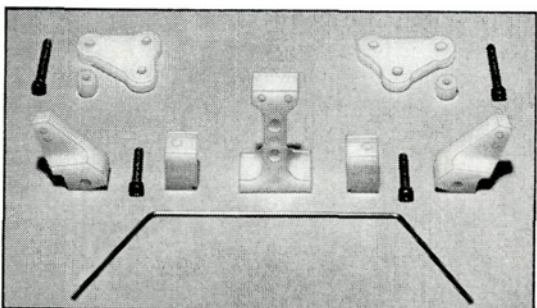
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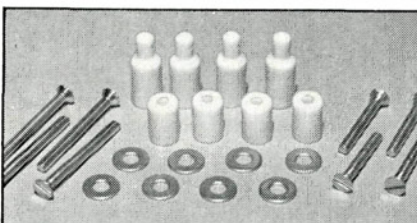
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PROJECT LAZER

(Continued from page 170)

LETTING YOUR GUARD DOWN

The Lazer features a fully enclosed belt-drive system. The front and rear drive units are connected with a timing belt (the longer of the two belts used on the Lazer). This is covered by a ladder-type belt guard. Chuck it! If you use a body with an under-tray, you don't need it. It just adds weight, and besides, believe it or not, I've found that dirt tends to remain in the drive system longer when this cover is in place.

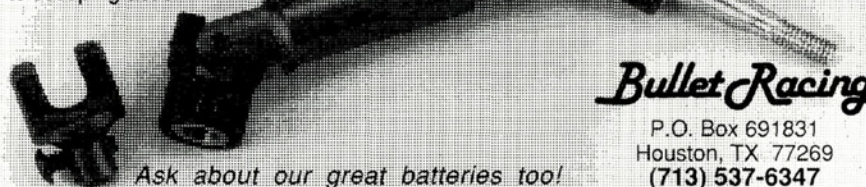
BITS & PIECES

In addition to these modifications, here's what I used to give Project Lazer that extra performance edge. The Lazer is supposed to be Kyosho's top-of-the-line 4WD car, yet the kit doesn't include turnbuckle linkage for the suspension. Once you use turnbuckles to adjust a car's suspension, nothing else will do. There are several brands and types of turnbuckle tie rods on the market, so the big choice is whether you want to use steel, aluminum, or titanium. For this application, I went with Technacraft* titanium tie rods,

(Continued on page 188)

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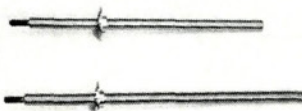
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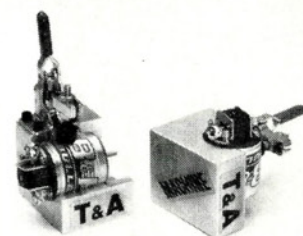
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PROJECT LAZER

(Continued from page 185)

which are available in pairs in a variety of lengths, or in complete packages that are designed to fit specific cars.

If you look closely at the shocks on Project Lazer, you'll notice that they're quite different from those found on the stock kit. They've been hard-anodized, which makes them infinitely more durable than the normal gold-anodized shocks (and they look "trick"!). I also used RPM* Quick-Adjust spring spacers in place of the kit's shock collars.

The stock Lazer rims are fine, but the kit's tires are definitely not up to the requirements of heavy competition. I received a full set of optional Kyosho tires with the Lazer, and they were the new 2.2-inch H-pattern tread, W-5631 narrow (front), and W-5641 (rear). I used a full set of HPI's new Super Star 2.2-inch rims to go with these cutting-edge tires.

There are two schools of thought about battery and motor combinations. Some racers use 7-cell SCE batteries and 14- to 21- turn motors, but the new approach seems to be 6-cell SCR (1400mAh) batteries and hotter motors (12- to 15-turn). I like the latter. It's so much easier to

maintain SCRs; they can handle more abuse, and they can be used more than once during the day without any perceptible change in performance. When you use them with a hotter wind, your car's acceleration and top speed are on a par with those of a 7-cell SCE-powered car. For Project Lazer, I picked up a set of Powerline* matched 6-cell SCRs and hooked them up to a Novak* 410-MXc high-frequency ESC. For efficiency and performance, the MXc is at the top of the heap.

Joined to the other end of the Novak ESC is an HPI UNO 14-turn double motor. Talk about horsepower! Anyone who thinks that six cells aren't enough to motivate a 4WD car should see this thing go! Because all the horsepower in the world won't mean a thing if the car doesn't turn when it's supposed to, I installed Futaba's* S9301 servo to handle the steering on Project Lazer. With 69.7 ounces of torque and a 60-degree transit time of .22 second, this servo is perfect for a 4WD off-road car.

Rounding out the list of electronics is Novak's NER-2X micro receiver. Space is limited on the Lazer, but this receiver fit in perfectly, and it's just as reliable as

the larger units that come with the radio systems.

Finally (whew!), controlling all this is a KO-Propo* EX-1 transmitter. I've been using one of these for a while, and I find it reliable and easy to use, mostly owing to its high-quality electronics and superb ergonomic design. If you're in the market for a new radio but aren't sure if you need one that can also get ESPN, then check this radio out.

I decided to use a body and under-tray that were originally designed for Kyosho's Optima Mid long-wheelbase conversion kit. To me, this body is much better looking than the stock one.

LAZER LACQUER

I'm not usually too crazy about painting car bodies, but for this one, I decided to try Dahm's* Pro-Mask. This semi-transparent sheet makes masking windows a breeze: trace the window outlines onto the masking sheet from the outside of the body; cut the windows out; and apply them to the inside of the body. I also used the Pro-Mask to create the rest of the body's design.

(Continued on page 196)

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PROJECT LAZER

(Continued from page 188)

PROJECT LAZER PERFORMANCE

The car's initial setup included the following: up front, I set the wheels for zero degrees of toe and 1 to 2 degrees of negative camber (the tops of the tires leaning in); I filled the front and rear shocks with 30W Associated Silicone Shock Oil and used the kit's black medium springs. In the rear, I positioned the upper camber link so that the car would have slightly progressive negative camber as the suspension compressed. Finally, I set ride height so that the front of the car was about $\frac{3}{8}$ inch from full suspension extension and the rear sat with the A-arms parallel to the ground after I had dropped it from about one foot off the ground. (Always set your ride height with the car in ready-to-run form.)

Project Lazer's first run was at the photo shoot. Although the track was extremely dry and dusty, the Kyosho H-pattern tires stuck like glue. I wish that ROAR would legalize 2.2-inch rims, because most of the new European and Japanese tire technology revolves around this slightly bigger rim, and American racers (specifically those who participate in ROAR-sanctioned events) can't use these new tread designs.

Because I had driven a Kyosho Lazer with seven cells before, I noticed a difference with the six cells almost immediately—but it wasn't bad. Gone was the sometimes-uncontrollable off-the-line torque of the 7-cell car, but I did notice that, in many instances, it was easier to control the 6-cell Lazer. The increased "drivability" attained by using only six cells gave me a slightly broader (but noticeably so) power band. Because I used a "hot" HPI wind, the Lazer achieved nearly the same top speed as a 7-cell car, but again, it was more controllable.

My only regret is that owing to a deadline, I wasn't able to replace the kit's aluminum shock towers with fiberglass or graphite ones. (Aluminum shock towers often bend during collisions.) These aftermarket shock towers are, however, readily available if you want to add a set to your car.

I've driven almost every 4WD car imaginable, and the Kyosho Lazer has always impressed me with its sophisticated suspension design, its durability and its ease of maintenance. With the suggested modifications, Project Lazer is even more impressive. I bolted on every

(Continued on page 198)

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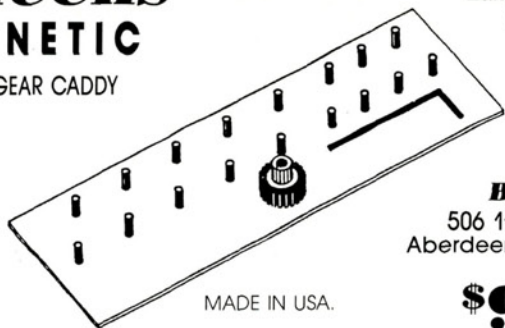


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PROJECT LAZER

(Continued from page 196)

after-market piece without a problem, and apart from the subtle chassis machining, each of the modifications can easily be duplicated on your Lazer.

*Here are the addresses of the companies mentioned in this article:

Kyosho/Great Planes Model Distributors, P.O. Box 4021, Champaign, IL 61824.

MK Engineering, P.O. Box 216, Seymour, CT 06483.

Associated Electrics, 3585 Cadillac Ave., Costa Mesa, CA 92626.

Peak Performance, 1362 E. Edinger - Bldg. B, Santa Ana, CA 92705.

Du-Mor R/C, 1002 Union Landing Rd., Cinnaminson, NJ 08077.

HPI, 22600-C Lambert St., Suite 904, El Toro, CA 92530.

A&L Mfg., P.O. Box 2115, Corona, CA 91718.

Technacraft, 1335B Dayton St., Salinas, CA 93901.

RPM, 14978 Sierra Bonita La., Chino, CA 91710.

Powerline Cells, 2537 Norwood Ave., North Bellmore, NY 11710.

Novak Electronics, 128-C E. Dyer Rd., Santa Ana, CA 92707.

Futaba Corp. of America, 4 Studebaker, Irvine, CA 92718.

KO-Propo; distributed by Global Hobby Distributors, 10725 Ellis Ave., Fountain Valley, CA 92728.

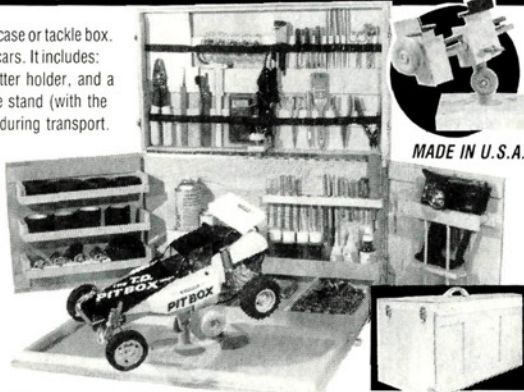
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The **T.D. PIT BOX II** holds 1/10 and 1/12 on and off road cars and comes assembled in unfinished birch ply. Measuring 25"W x 14 1/2"D x 14 1/2"H when closed, the **T.D. PIT BOX II** is designed to keep your gear organized and put an end to fishing for tools at the track.

The **T.D. PIT BOX II** with Car Stand Included is only \$89.95 + \$10 Shipping. Car Stand Available Separately for \$19.95 + \$3.00 Shipping. (Check, M.O. or COD Only) Ohio res. add 6% sales tax. Order Yours Today!



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1-800-253-7229 ORDERS ONLY **T.D. ENTERPRISES** **PIT-BOX II**

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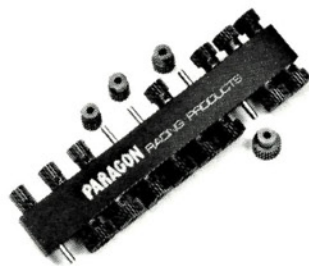
Eclipse™ Series Motors
(ECO 13, 15, 17, 19, 20, 23)



Ground Effects™
Traction Compound (GE013)



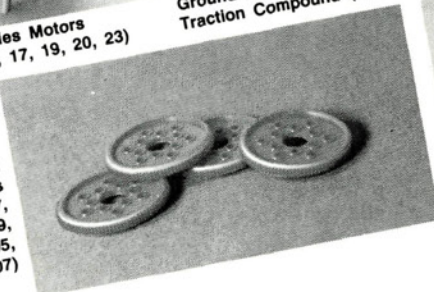
Liquid Bearings™ (LB025)
Moly/Graph Lubricant



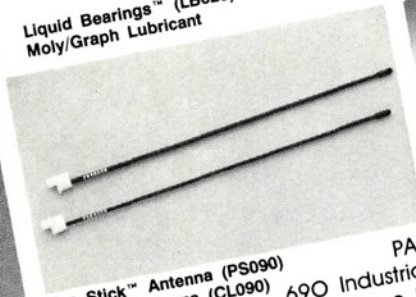
Gear Caddy™ (GC020)



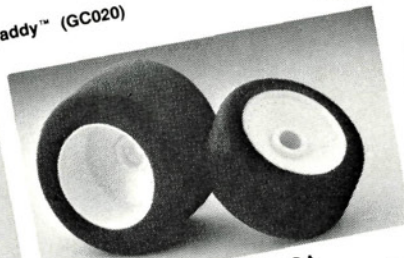
Ultralite™ (UL035)
Teflon Lubricant



ProLite™
Odd Tooth
64 Pitch
"Cut" Gears
(PL097,
PL099,
PL105,
PL107)



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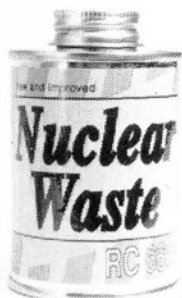
WHAT'S NEW



TRINITY Off-Road Wheels and Tires

Trinity has released its new ROAR-legal, wheels—Gumballs—in two sizes: 2 inches (rears) and 2.1 inches (fronts). Made of an all-new rubber compound, they're designed to fit all three-piece and one-piece rims. To go with them, Trinity offers ultralight, nylon, three-piece Modular Wheels.

Prices: \$9.99, Gumball Racing Tires; \$5.99, Modular Wheels.



Nuclear Waste

Trinity's tire-traction compound—Nuclear Waste—is especially for "capped" or "radial" tires running on concrete. It will condition the rubber and help you avoid starting-line problems.

Price: 6.99/4-ounce container

Part no: RC 6666

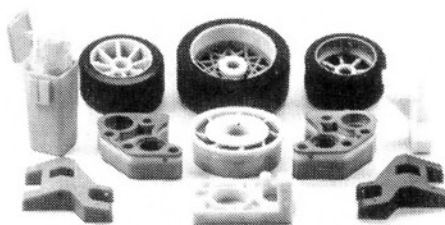
For more information, contact Trinity Products, Inc., 1901 E. Linden Ave., #8, Linden, NJ 07036.



SAIKO RACING PRODUCTS Combination Motor/Battery Case

This new combo case is ideal for racers who want to protect their prized motors and batteries from static electricity, dust and shorting. This special anti-static foam won't attract static-charged dust particles, and it provides the best protection available.

For more information, contact Saiko Racing Products, P.O. Box 1515, Tustin, CA 92681.



LITESPEED Fluorescent Dy-Lon

LiteSpeed hot-pink and hot-yellow dyes provide brilliant, high-impact coloring for nylon and fiberglass parts. Mixed together, they produce fluorescent orange; they can also be mixed with LiteSpeed's custom Dy-Lons to make other fluorescent colors. One package makes 1 quart.

Part no. 0201

Price: \$3.49

For more information, contact LiteSpeed Inc., P.O. Box 4765, Spokane, WA 99202.

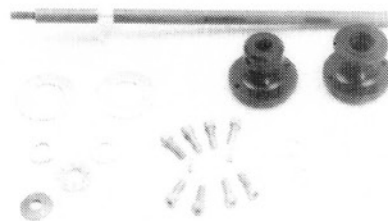


STAGE III T-Shirts

The new Stage III T-Shirts have arrived in blazing four-color neon! This new shirt features a demon in a series of colorful custom graphics on a white background. The shirts are 100 percent cotton, and they're available in sizes S through XXL.

Price: \$12.95

For more information, contact Stage III, The Ultimate Cell Test Inc., 1189 Chicago Rd., Troy, MI 48083.



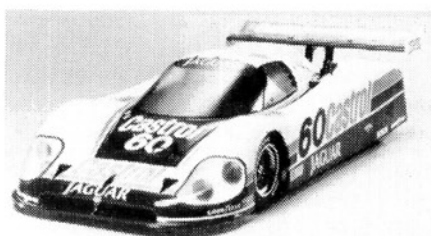
BOLINK R/C CARS Graphite Differential Kit

Lighten your load with Bolink's new Graphite Diff Kit. You get a graphite differential axle; light, precision-machined, Delrin hubs; aluminum wheel screws; and setscrews. All parts have been designed to be light and sturdy. Ball bearings are available separately (BL-5453).

Part no. BL-5704

Price: \$44.95

For more information, contact Bolink R/C Cars Inc., 420 Hosea Rd., Lawrenceville, GA 30245.

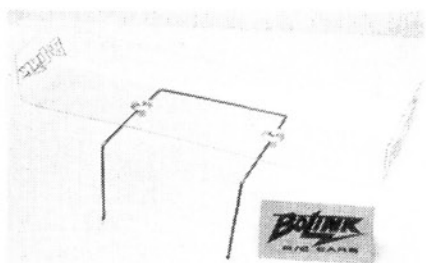


MRC/TAMIYA Jaguar XJR-12

The 1/10-scale Jaguar XJR-12 has the new, Tamiya-developed bathtub chassis. With its coil-spring front end and adjustable coil-over oil-filled rear shocks, the Jaguar's suspension can be adjusted easily. The kit is equipped with a three-speed forward-and-reverse speed controller, but you can use an electronic speed controller with this chassis. The Sport Tuned motor increases power for road racing. The sleek polycarbonate body is remarkably precise., and decals for the winning Daytona Speedway cars are included.

Part no. 58092

For more information, contact MRC, 200 Carter Dr., Edison, NJ 08817.



BOLINK Road-Racing Wing Kit

Bolink has modified its 8 1/2-inch wing and molded its logo into each side. It has also updated the hardware by adding light aluminum wing buttons at no extra cost.

Part no. BL-2735

Price: \$6

For more information, contact Bolink R/C Cars, Inc., 420 Hosea Rd., Lawrenceville, GA 30245.



BOLINK R/C CARS Graphite E-10 Kit

In addition to the wind-tunnel tested stock-car body, this kit features a graphite chassis, a graphite axle and front axle plate, a ball-type rear suspension with dual shocks, nine ball bearings, aluminum hubs, mounted tires and a wing kit.

Part nos. BL-1373S (stock-car body); BL1373R (road-racing body).

Price: \$249.95

For more information, contact Bolink R/C Cars Inc., 420 Hosea Rd., Lawrenceville, GA 30245.



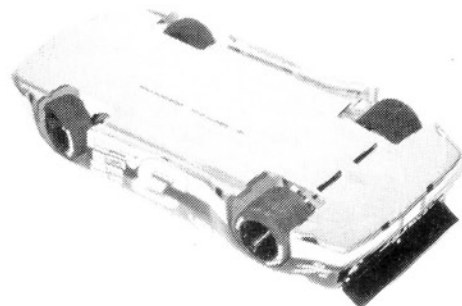
BOLD CREATIONS PowerBalls

Bold Creations' PowerBalls are made of a very hard chrome alloy. Their sphericity is accurate to within 25 millionths of an inch, so the balls are in equal contact with the diff rings. This provides super-smooth diffs that require little, if any, adjustment. PowerBalls are available in all popular sizes, including the 3mm size used in Schumacher cars. Best of all, PowerBalls are a bargain—enough for several diffs in each package.

Part nos. BC020 (1/8 inch); BC025 (3/32 inch); BC026 (1/16 inch); BC030 (3mm).

Price: \$4.95; \$3/30 balls (3mm).

For more information, contact Bold Creations, 1305 Abbey Rd., Round Rock, TX 78681.



DAHM'S RACING BODIES Thunderbodies™

Aerodynamic underbodies are available for all Dahm's standard and narrow NASCAR bodies! Dahm's Lexan Thunderbodies™ have an aerodynamic "ground effects" design, "air channels," body-mount slots and molded-in trim lines. They can be set up as full-length belly pans, or as three-quarter-length underbodies with underwings. Thunderbodies™ reinforce your car's body, protect it from crash damage and eliminate front-end chatter. They also protect the frame's bottom and add weight to its lowest point to improve handling!

Price: \$16.98 to \$35.98

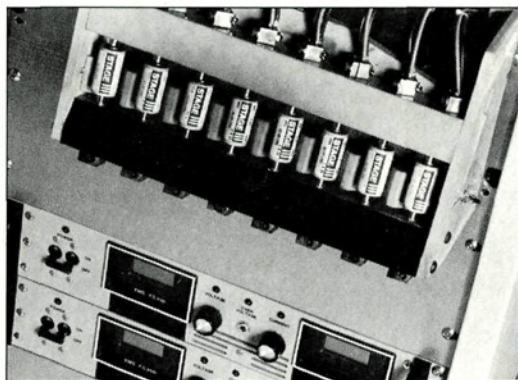
For more information, contact Dahm's Racing Bodies, P.O. Box 360, Cotati, CA 94931.

Descriptions of new products appearing on these pages were derived from press releases supplied by the manufacturers and/or their advertising agencies. The information given here does not constitute endorsement by **Radio Control Car Action**, nor guarantee product performance or safety. When writing to the manufacturer about any product described here, be sure to mention that you read about it in **Radio Control Car Action**.

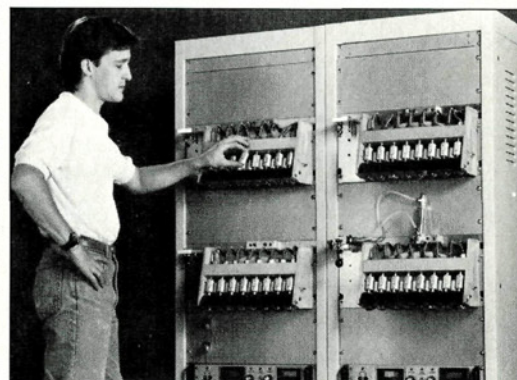
VARIABLE LOAD TESTING -- NOW AVAILABLE!

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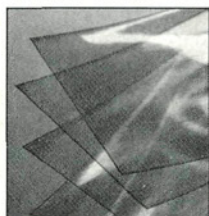
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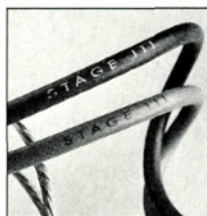


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R/C Car Action, Jan., 1991



SUPER 13

"The Best Wire in the Business of R/C..."
Competition Plus, August, 1989

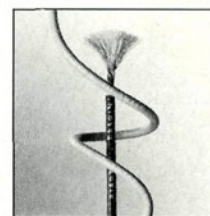
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